

# Wind Statistics Offshore based on Satellite Images

**Hasager, Charlotte Bay; Mouche, Alexis; Badger, Merete; Nielsen, Morten; Astrup, Poul; Karagali, Ioanna**

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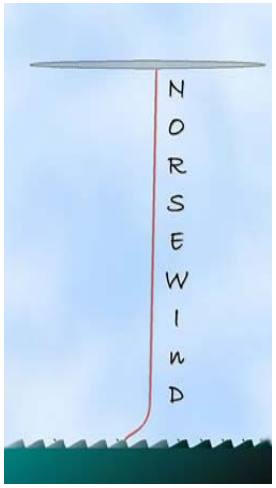
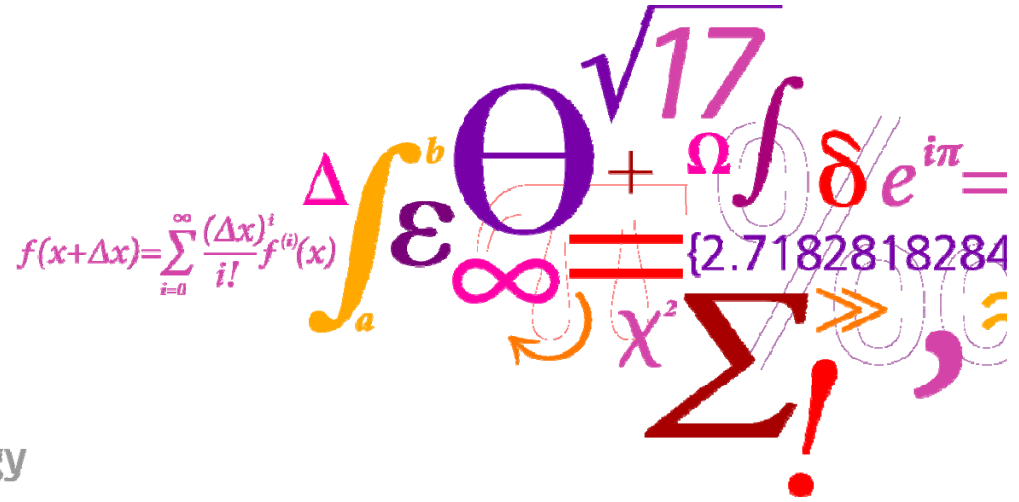
# Wind statistics offshore based on satellite images




Charlotte Bay Hasager, Merete Badger, Poul Astrup, Morten Nielsen, Ioanna Karagali, Risø DTU

Alexis Mouche, CLS, France

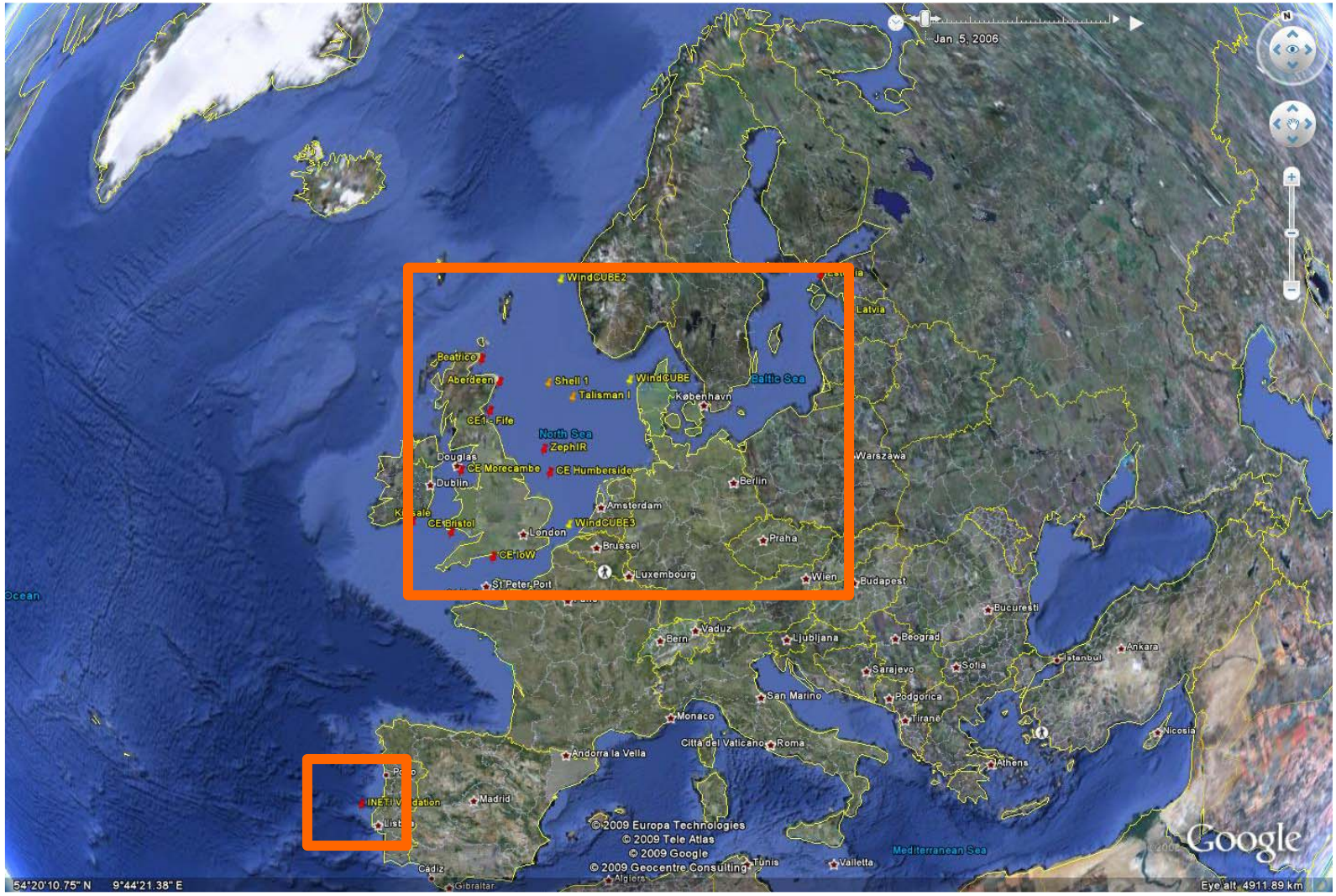



Risø DTU
National Laboratory for Sustainable Energy

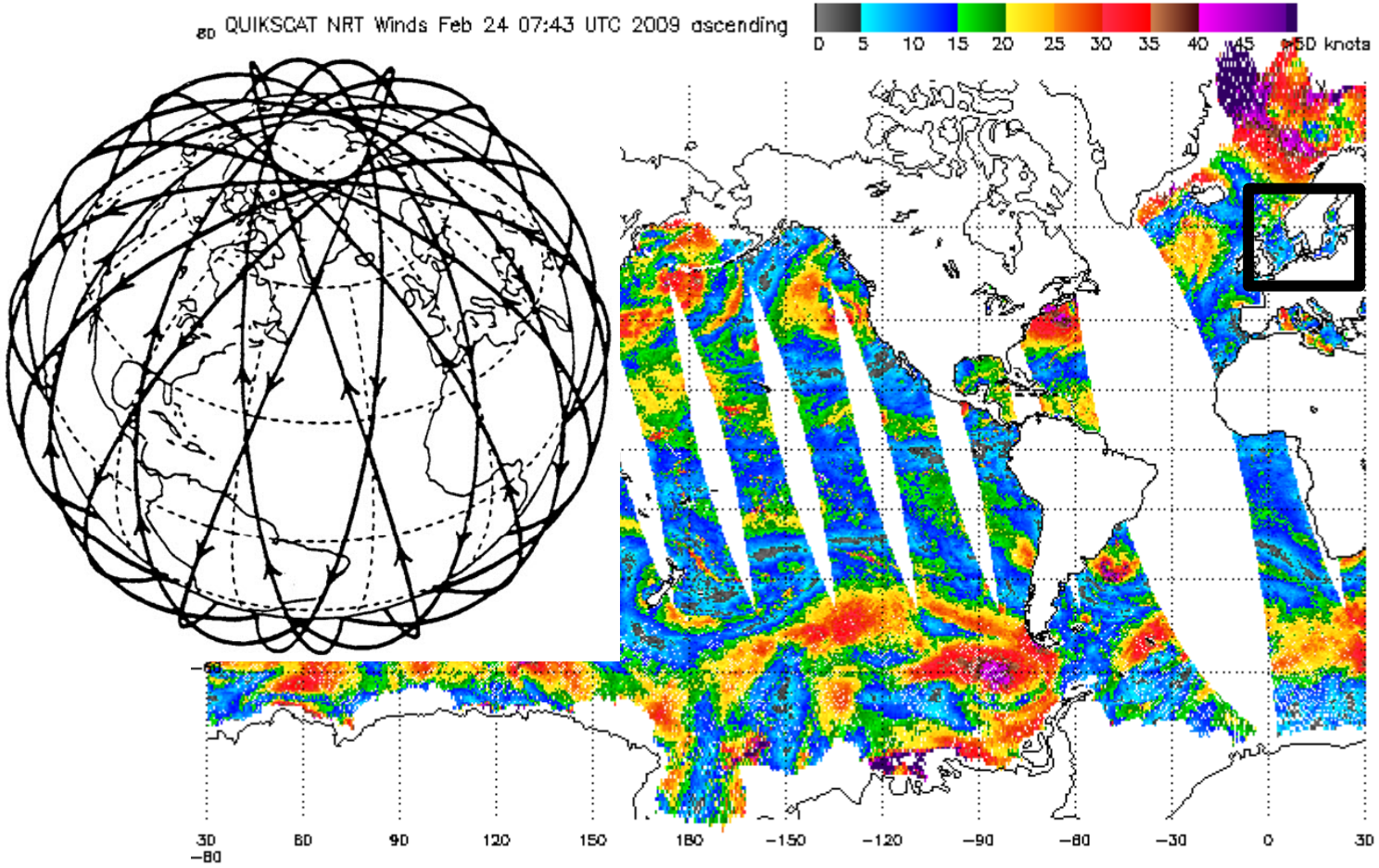
# Content

- Offshore sites
- QuikSCAT analysis
- Envisat SAR analysis
- Future

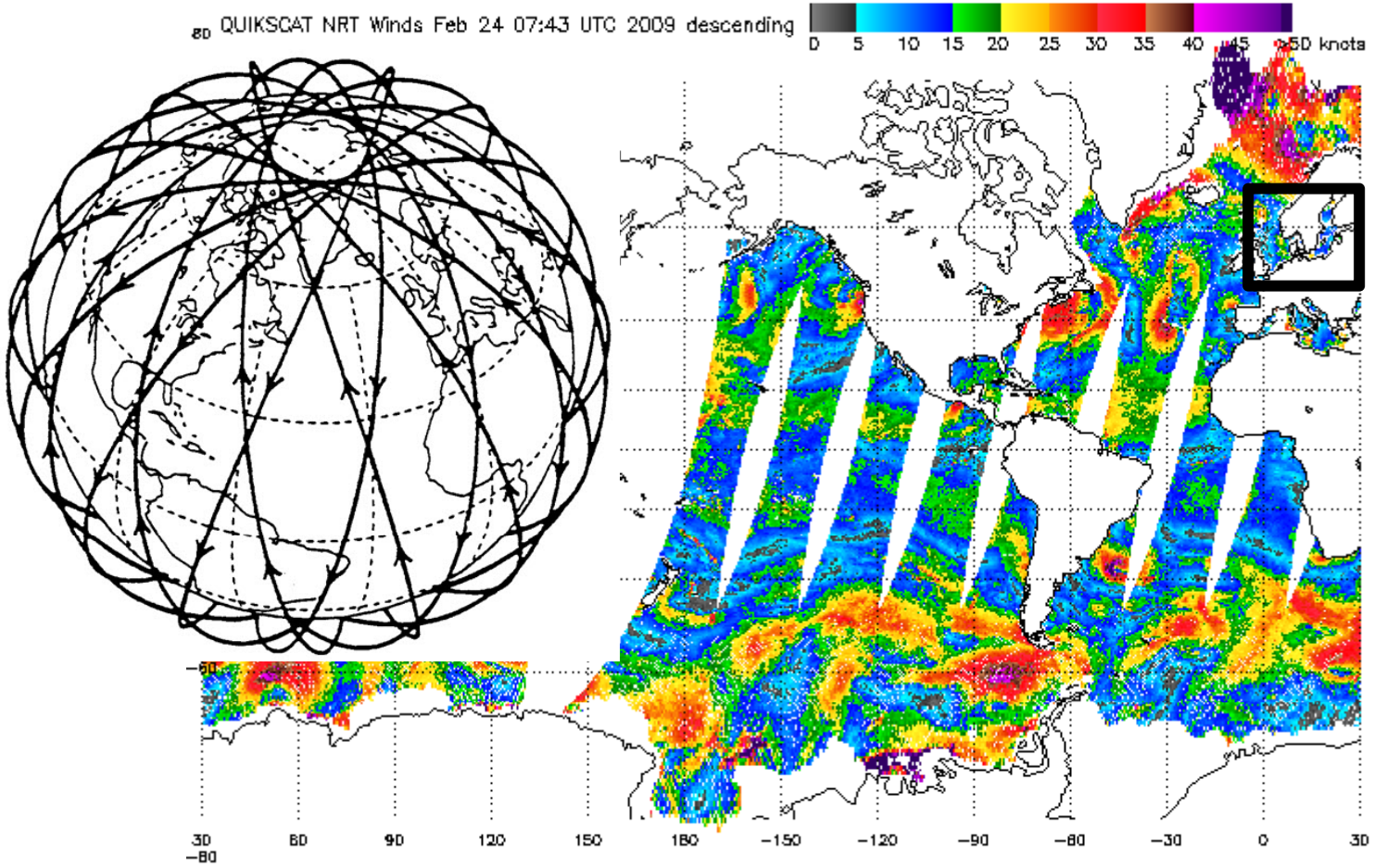
# Norsewind: project domain for offshore wind



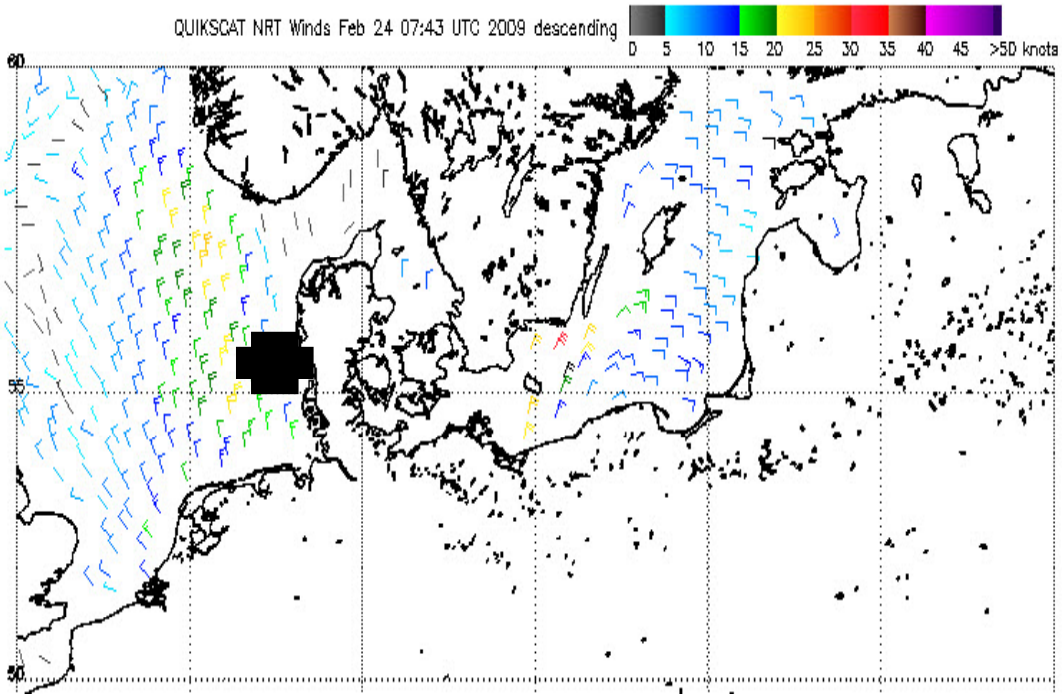
# Wind map: QuikSCAT - morning

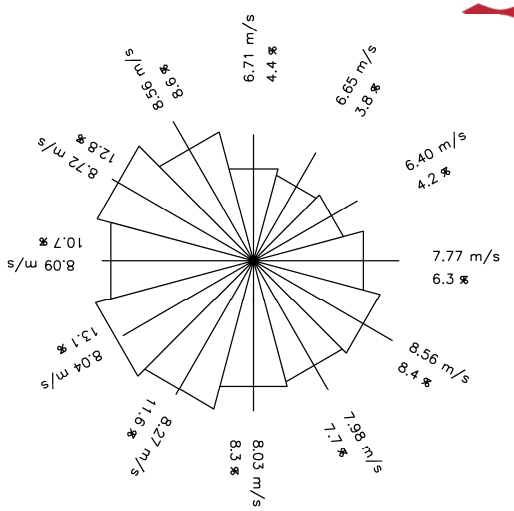


# Wind map: QuikSCAT – afternoon

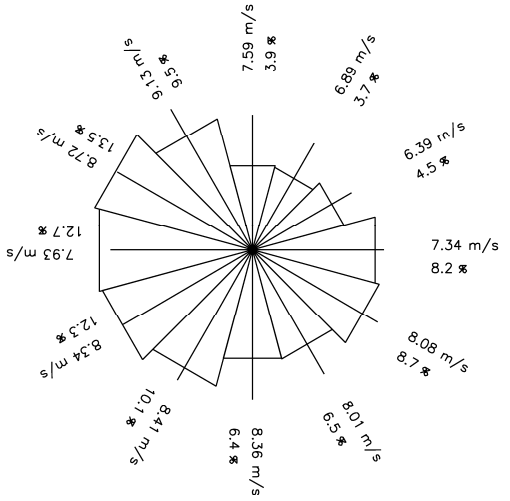


# Comparison at Horns Rev



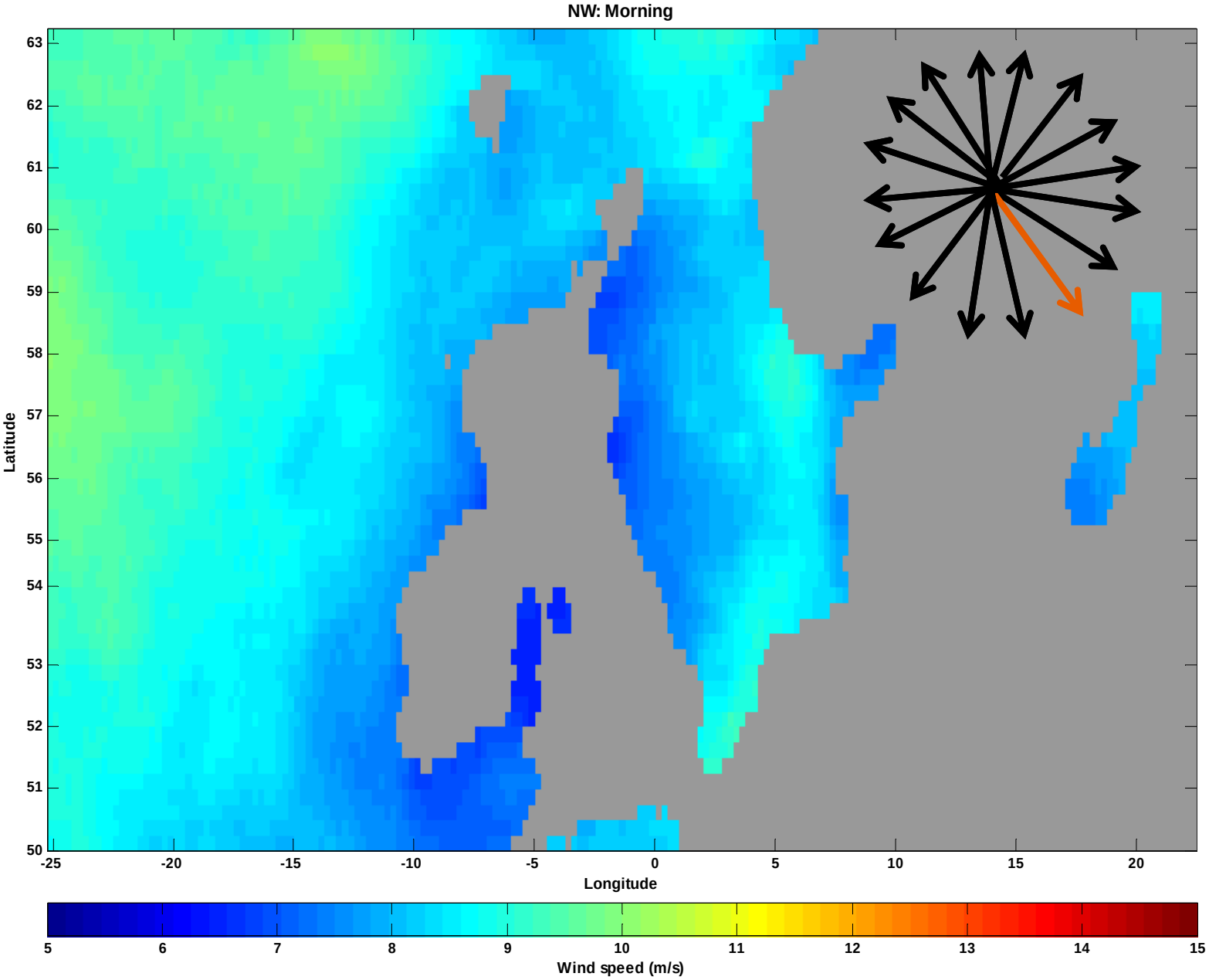

Mast (courtesy DONG energy)

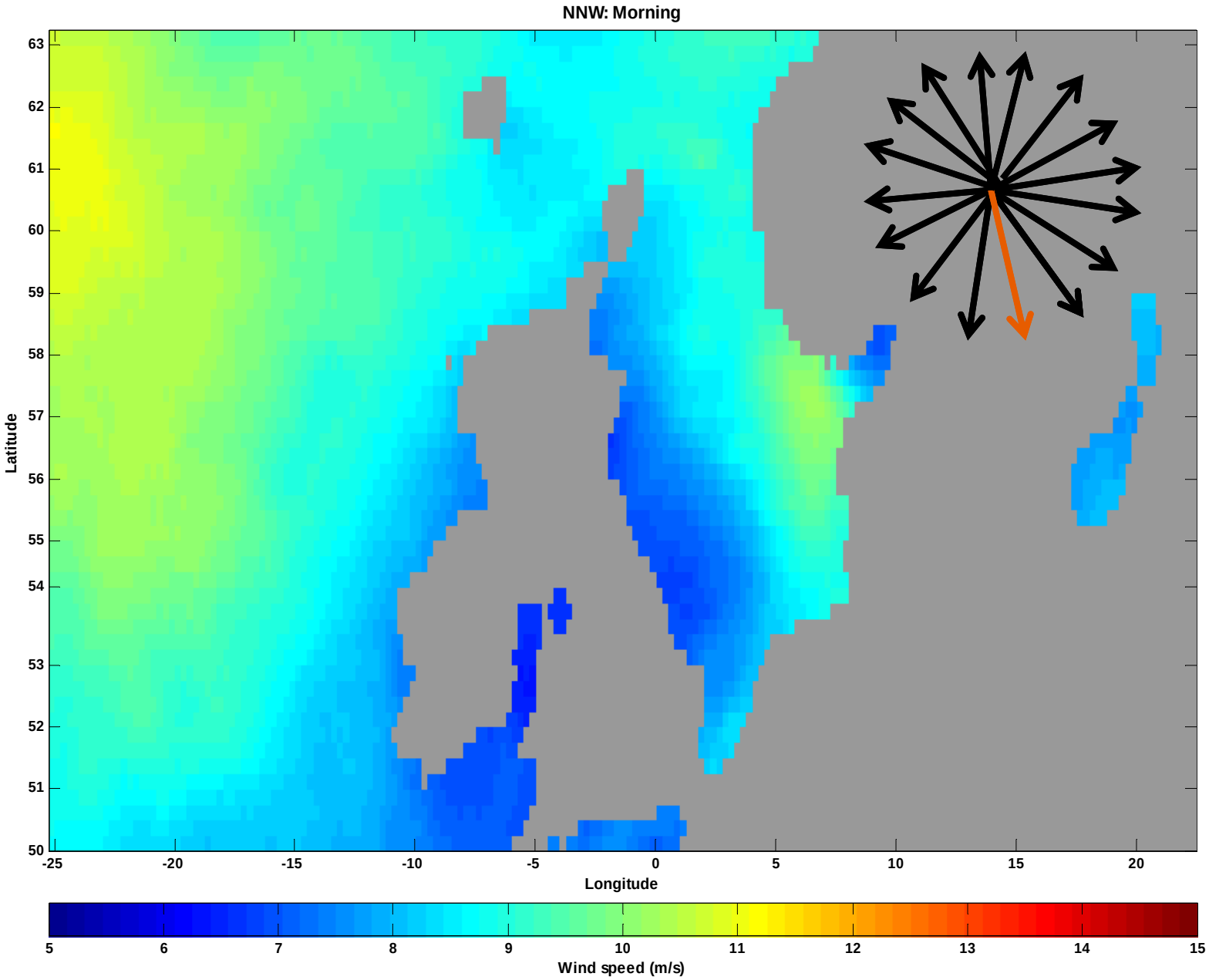



QuikSCAT

Hasager, C.B. A.Peña, M.B.Christiansen, P.Astrup, M.Nielsen, F.Monaldo, D.R.Thompson, and P.Nielsen. "Remote sensing observations used in wind energy." IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing 1, no. 1(2008):76-79

# Average Wind Speed: Morning (based on wind direction at Horns Rev) - 16 Directions




NNW: Morning
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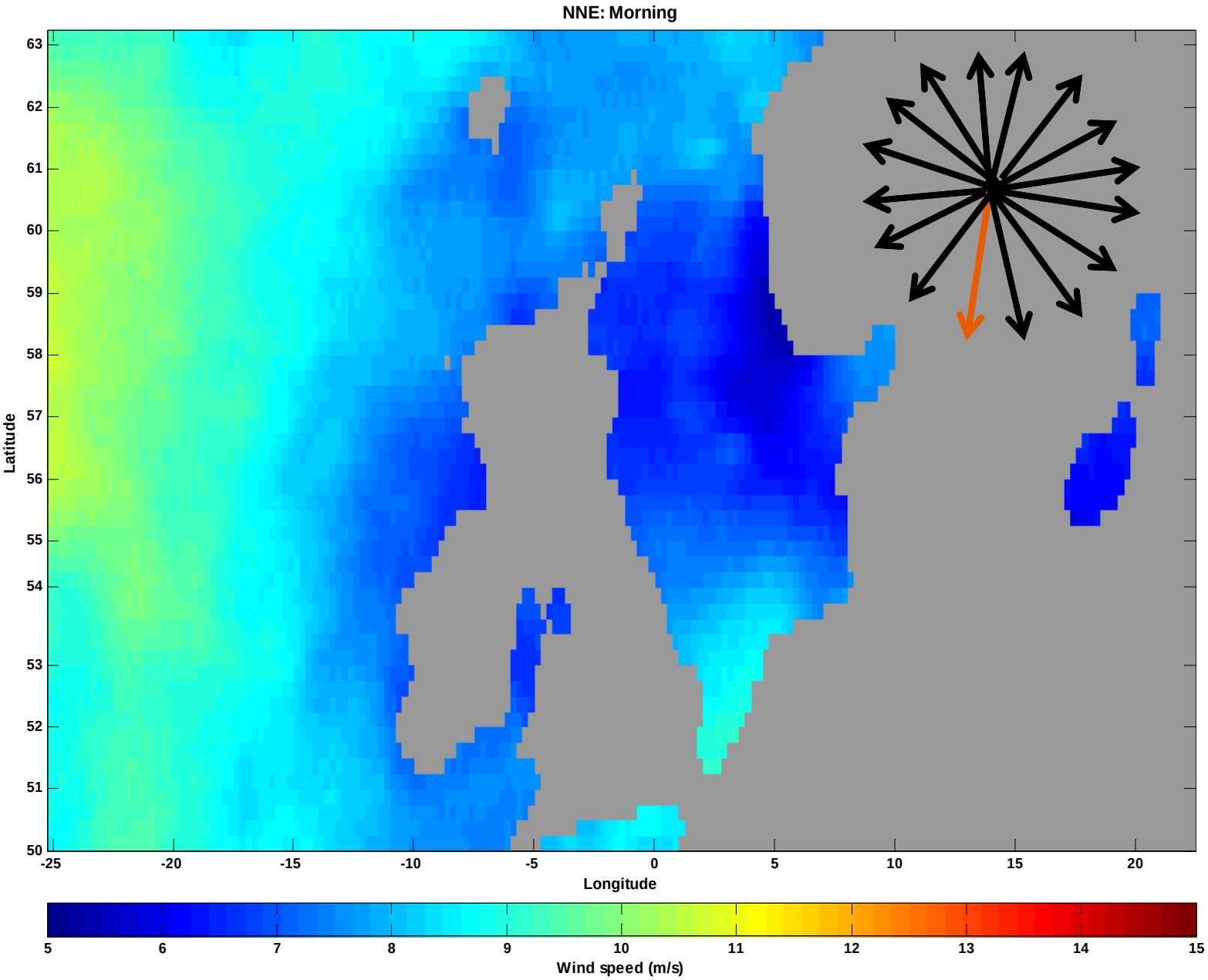
Wind speed (m/s)


NNE: Morning
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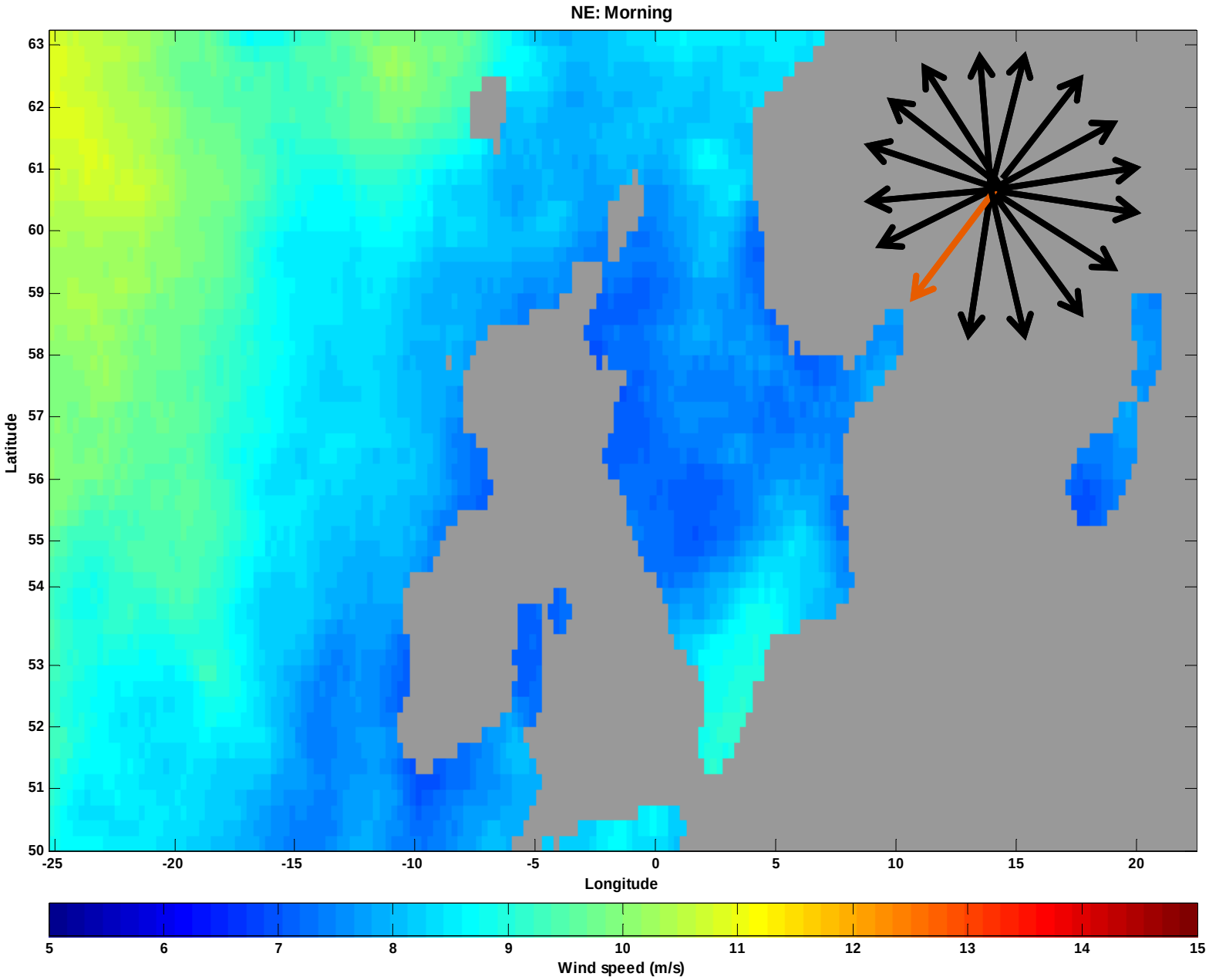
Wind speed (m/s)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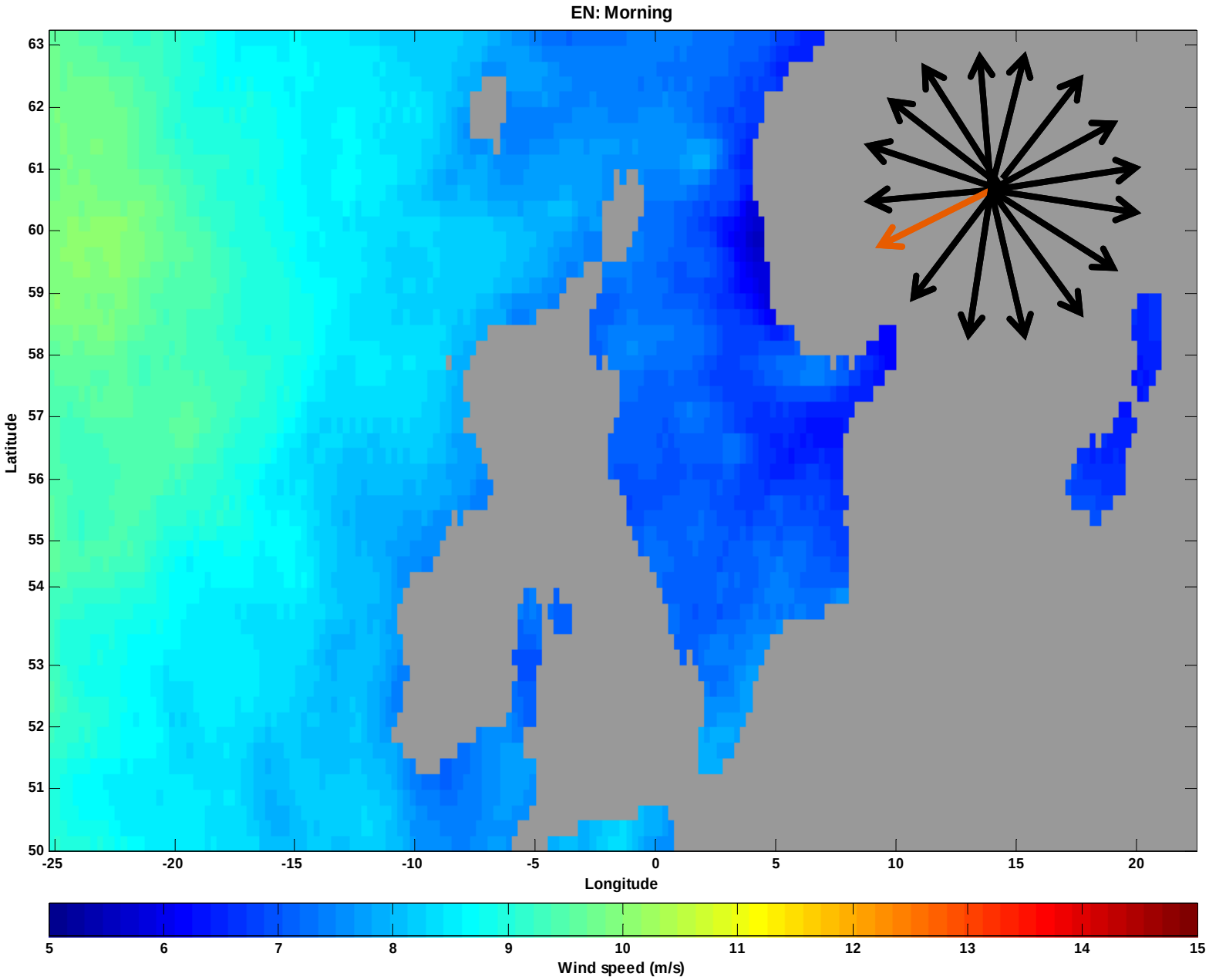
Wind speed (m/s)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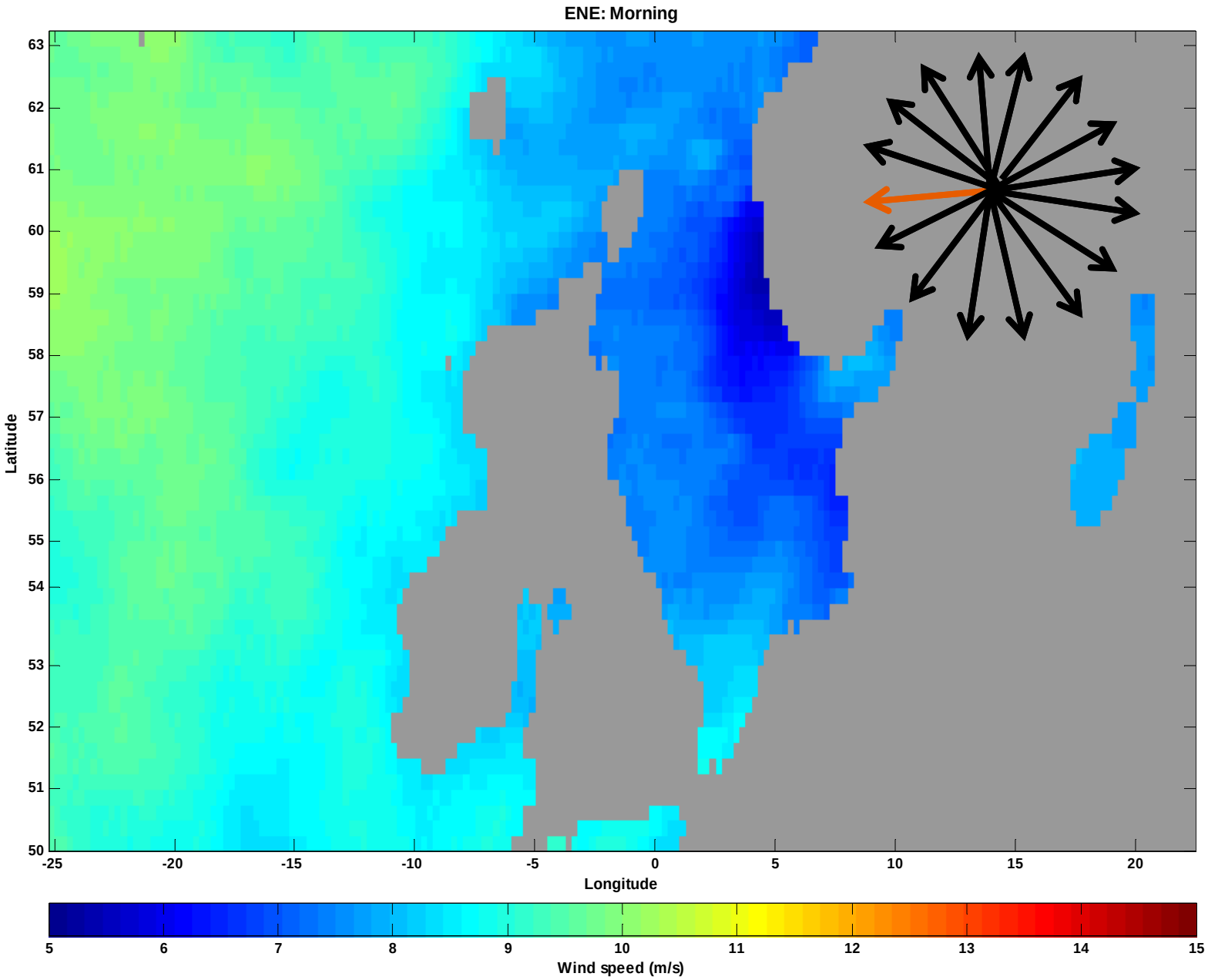
Wind speed (m/s)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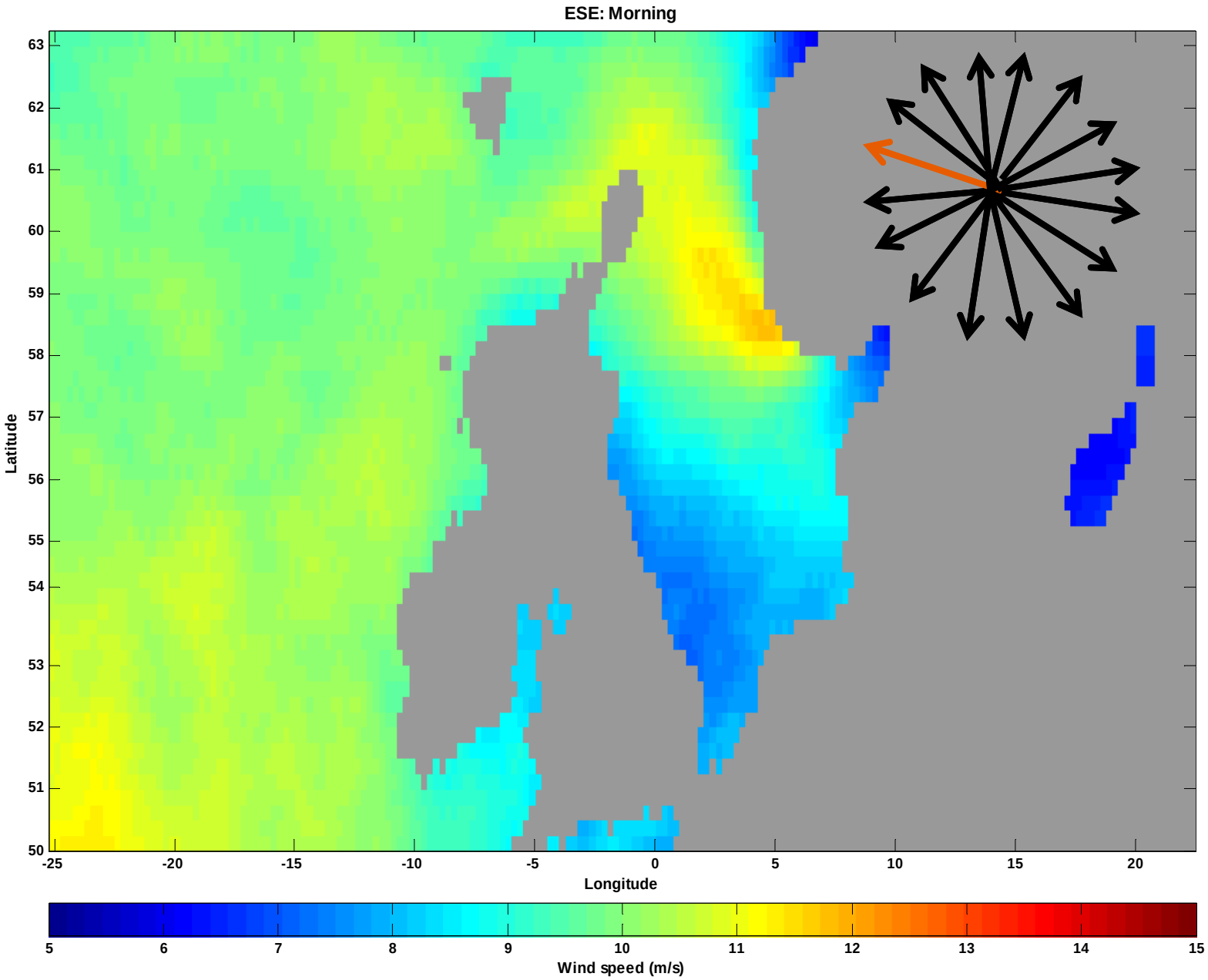
Wind speed (m/s)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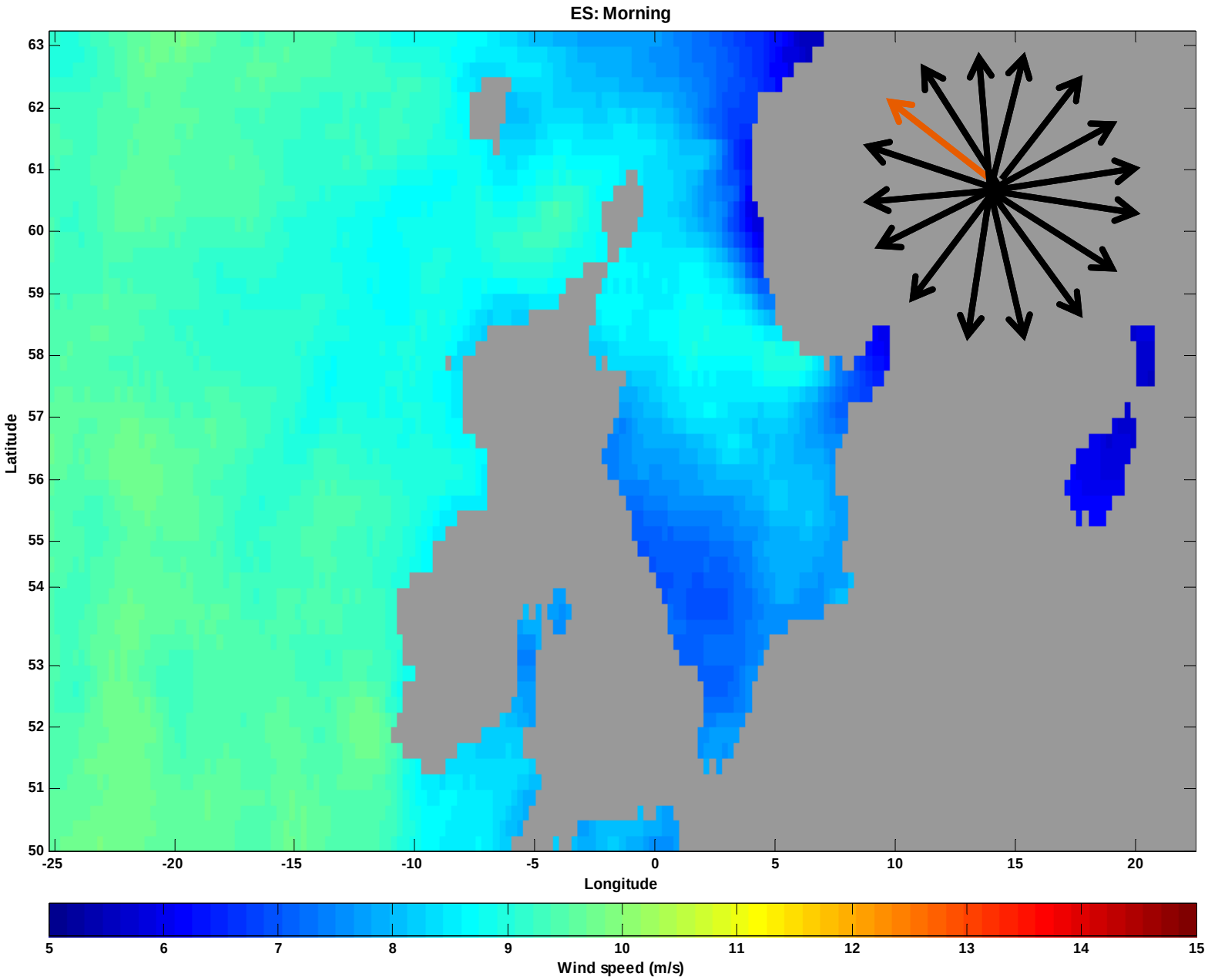
Wind speed (m/s)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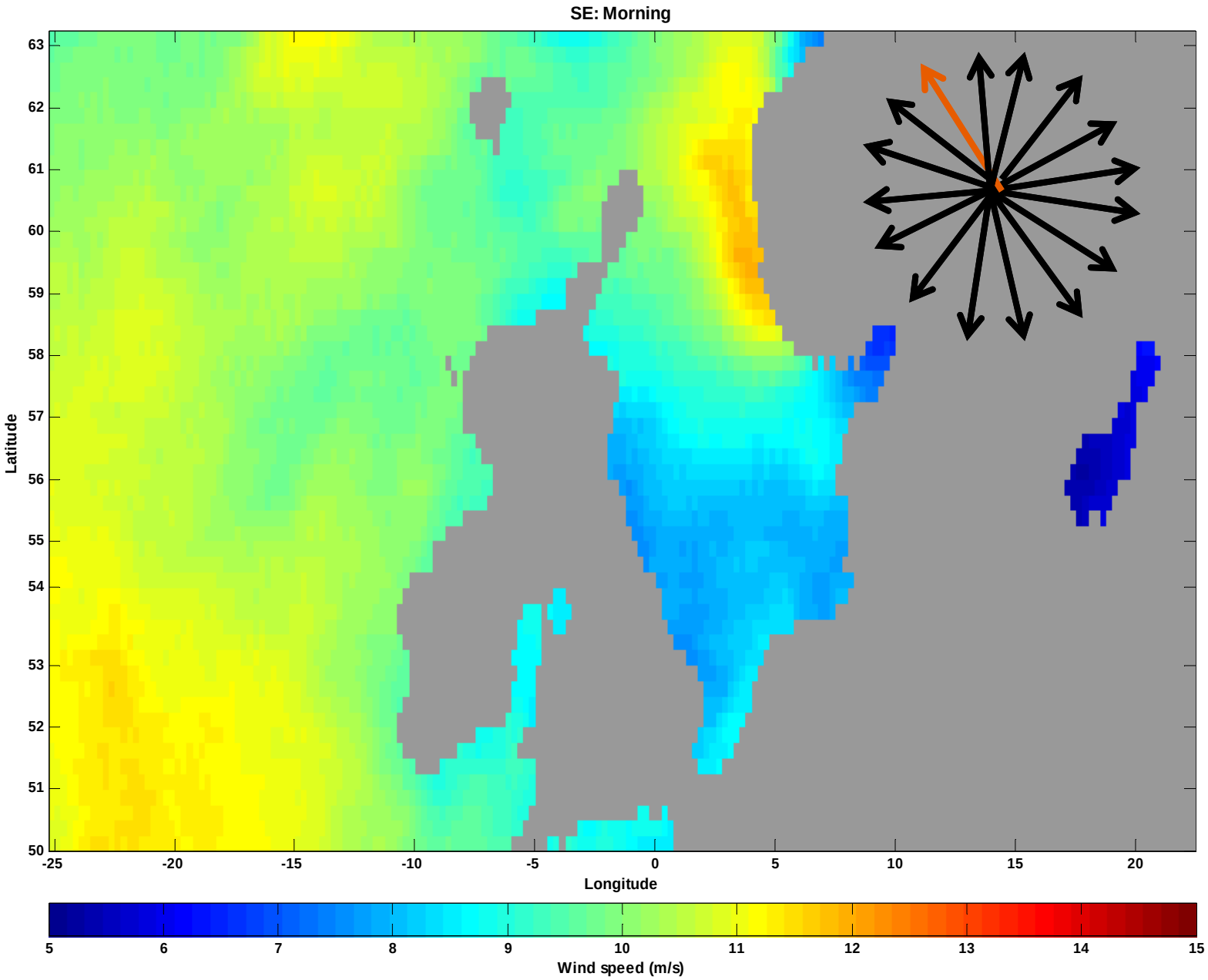
Wind speed (m/s)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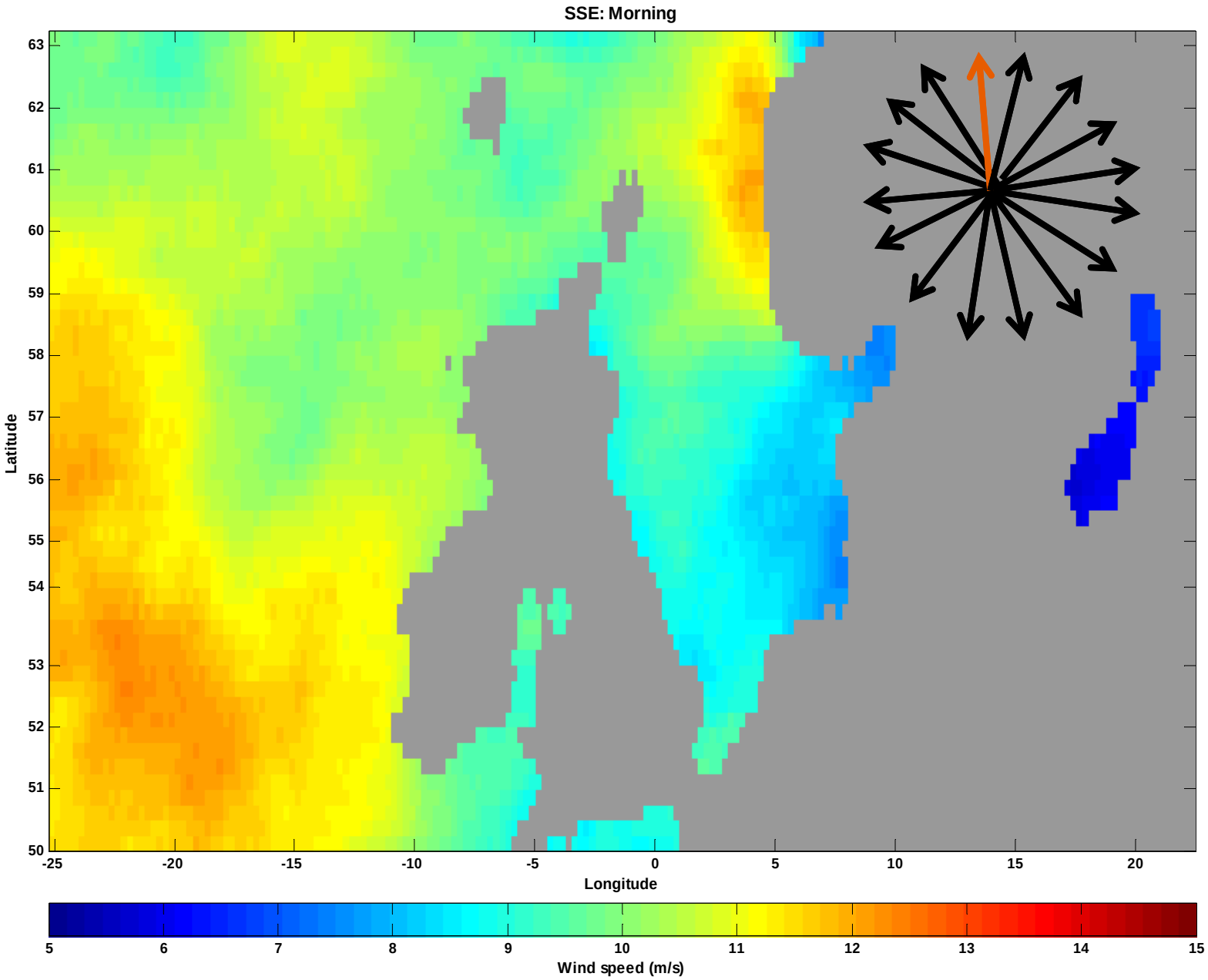
Wind speed (m/s)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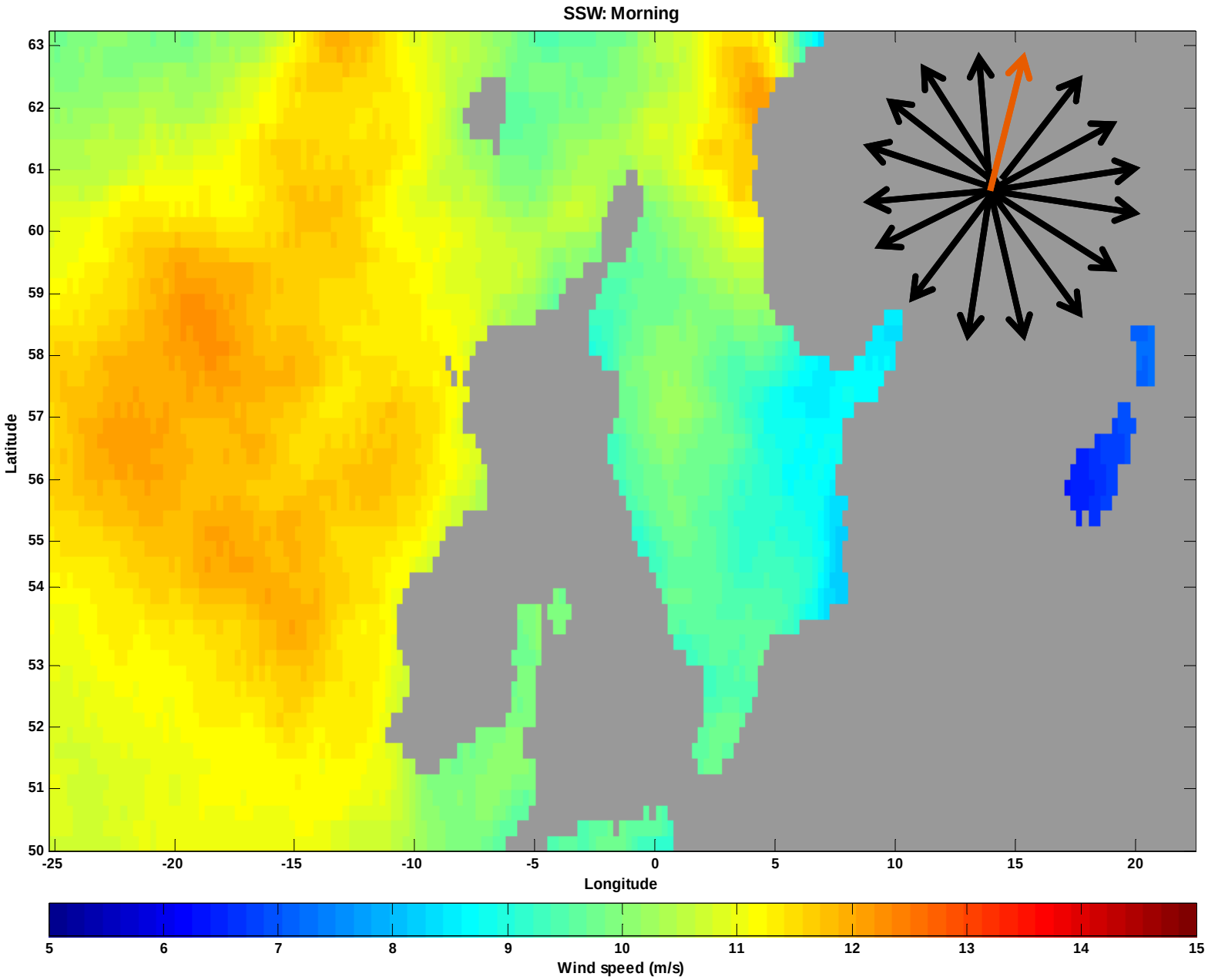
Wind speed (m/s)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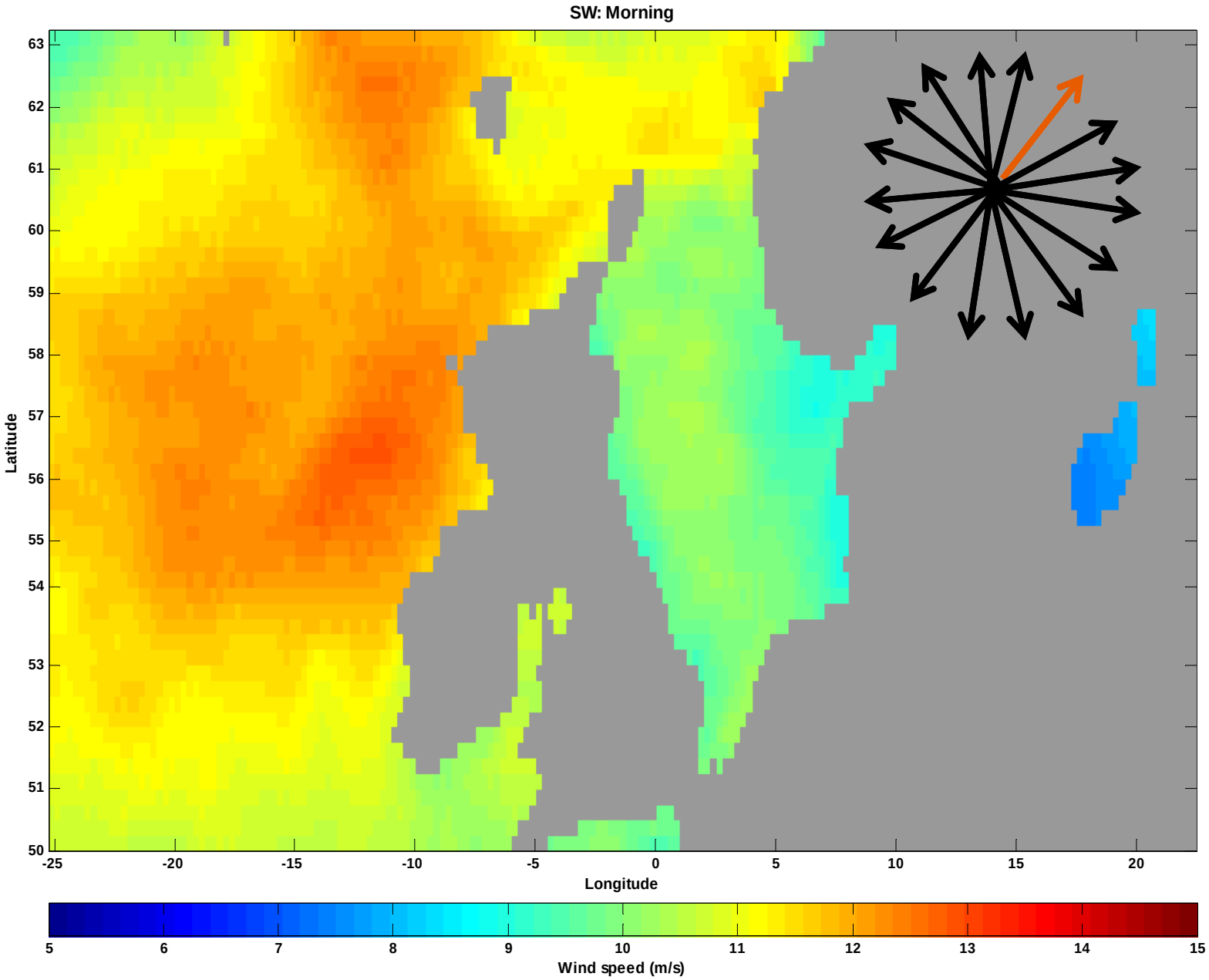
Wind speed (m/s)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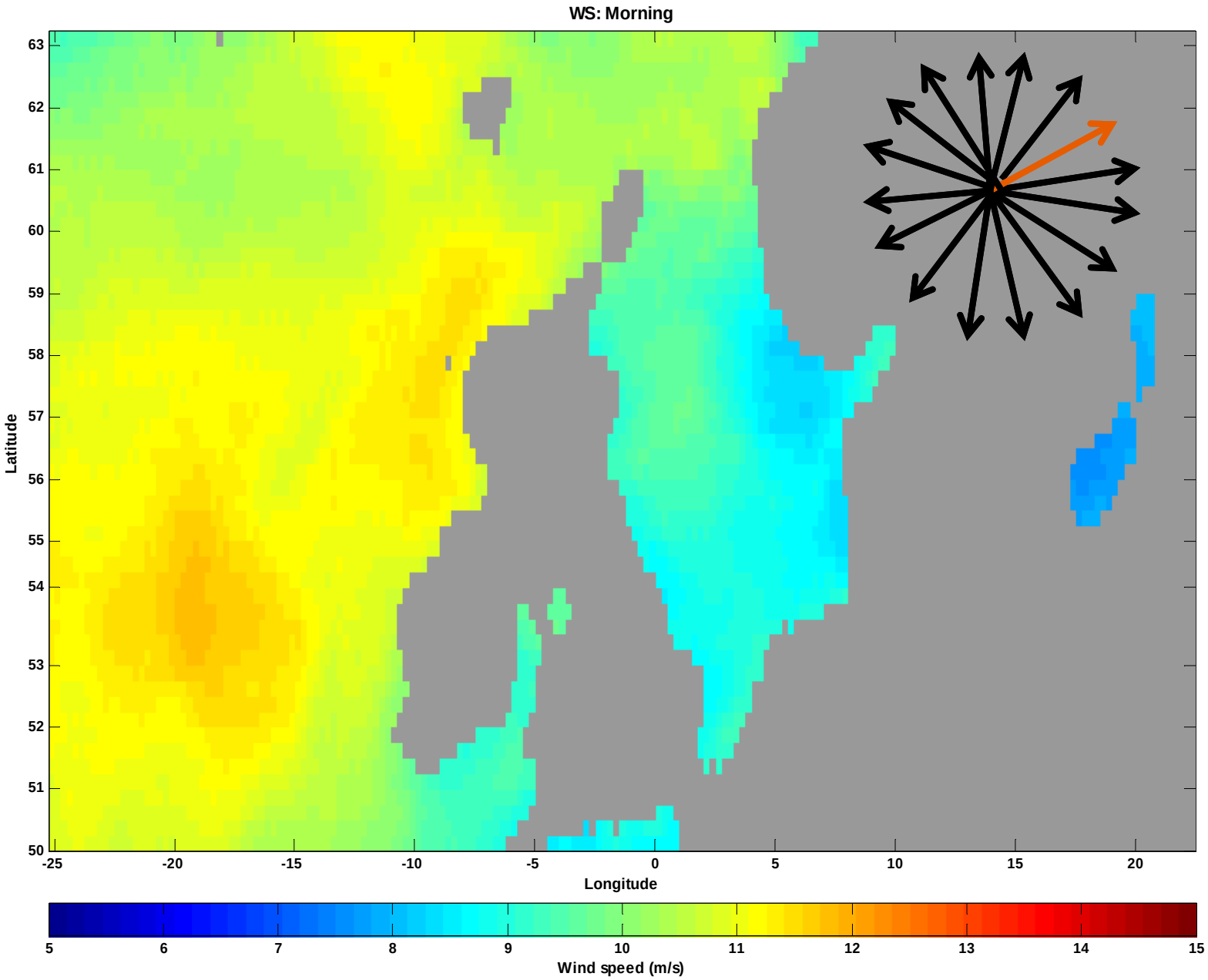
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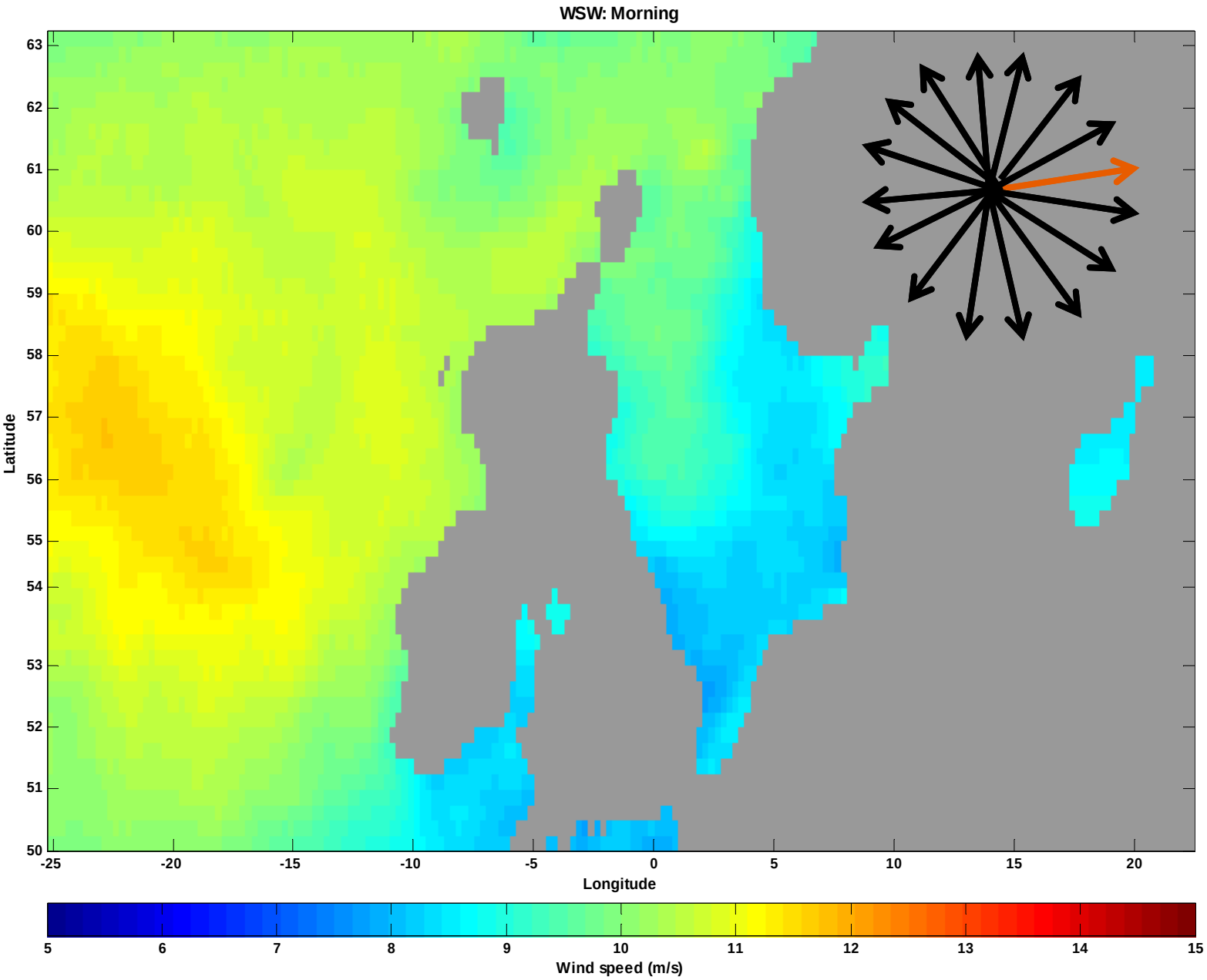
Wind speed (m/s)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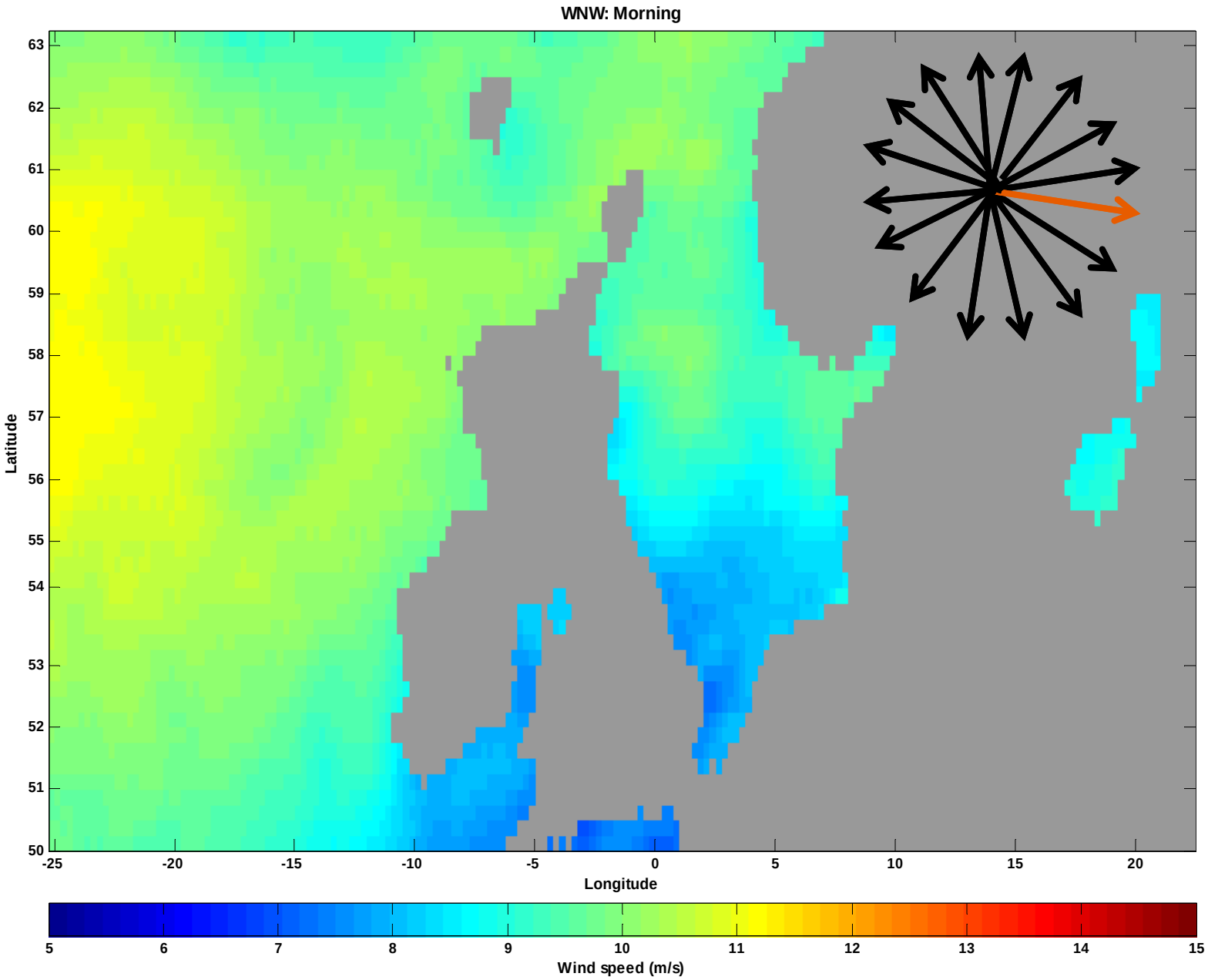
Wind speed (m/s)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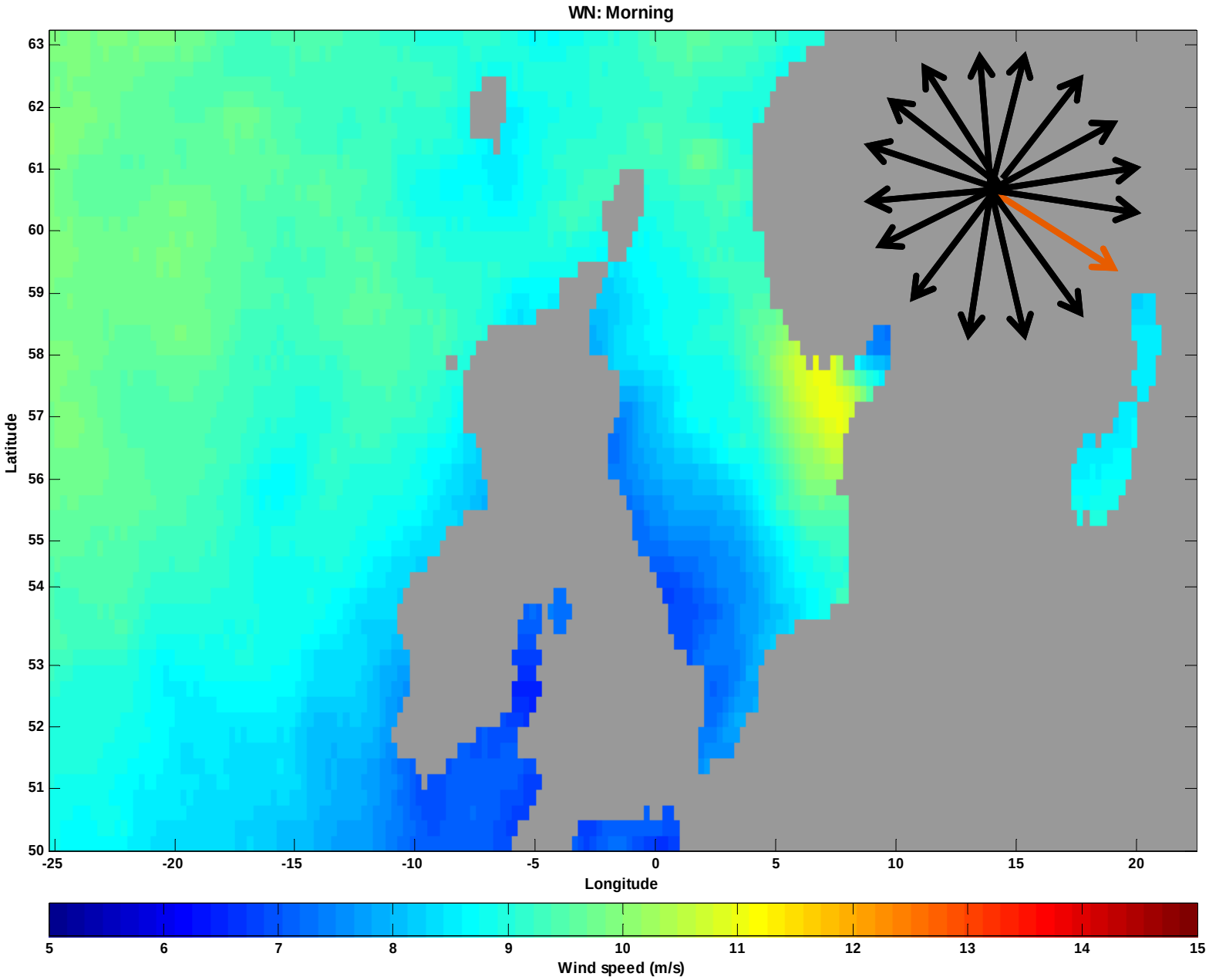
Wind speed (m/s)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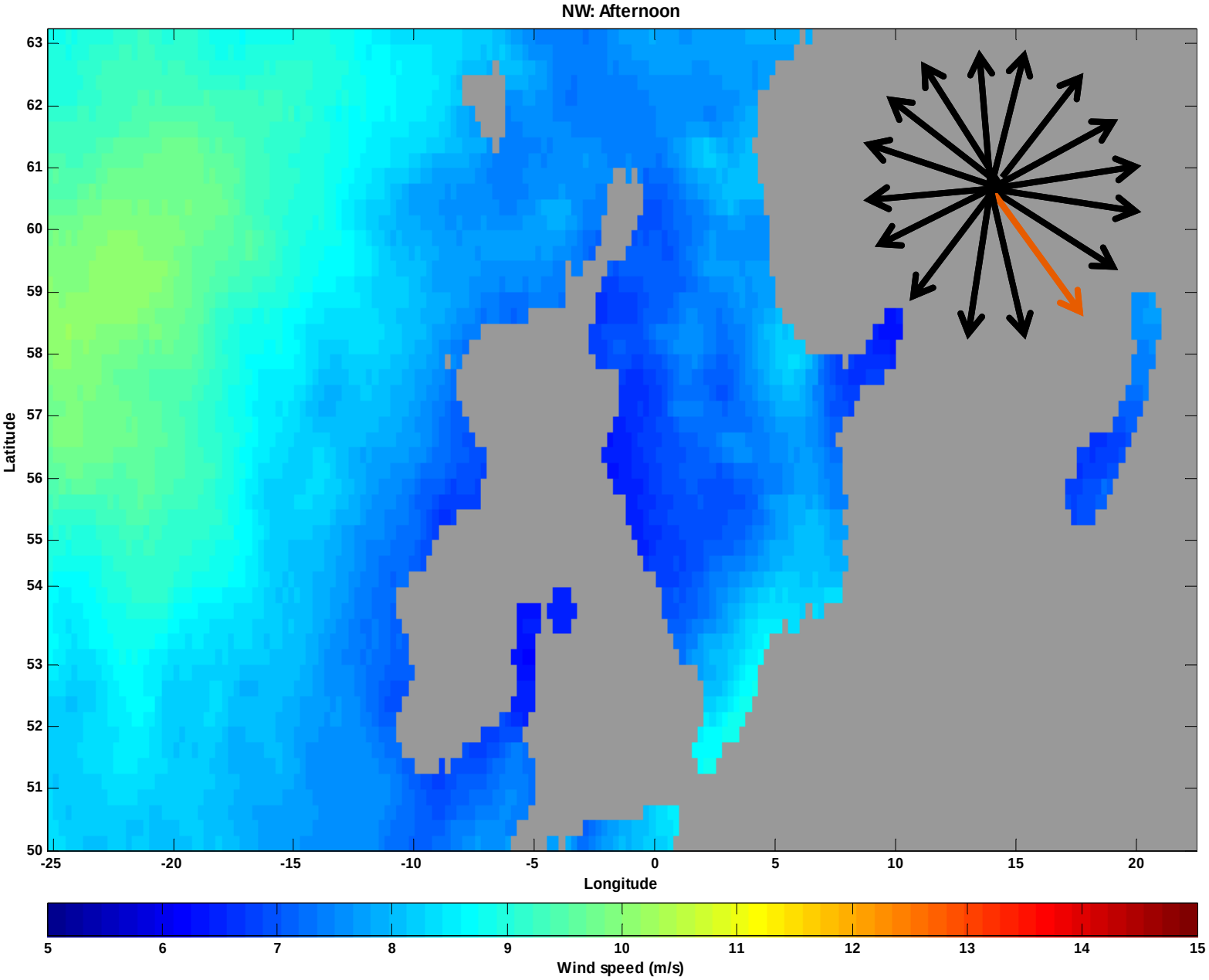
Wind speed (m/s)

# Wind maps

## ~ 3500 morning
## ~ 3500 afternoon

# Average Wind Speed: Afternoon (based on wind direction at Horns Rev) - 16 Directions

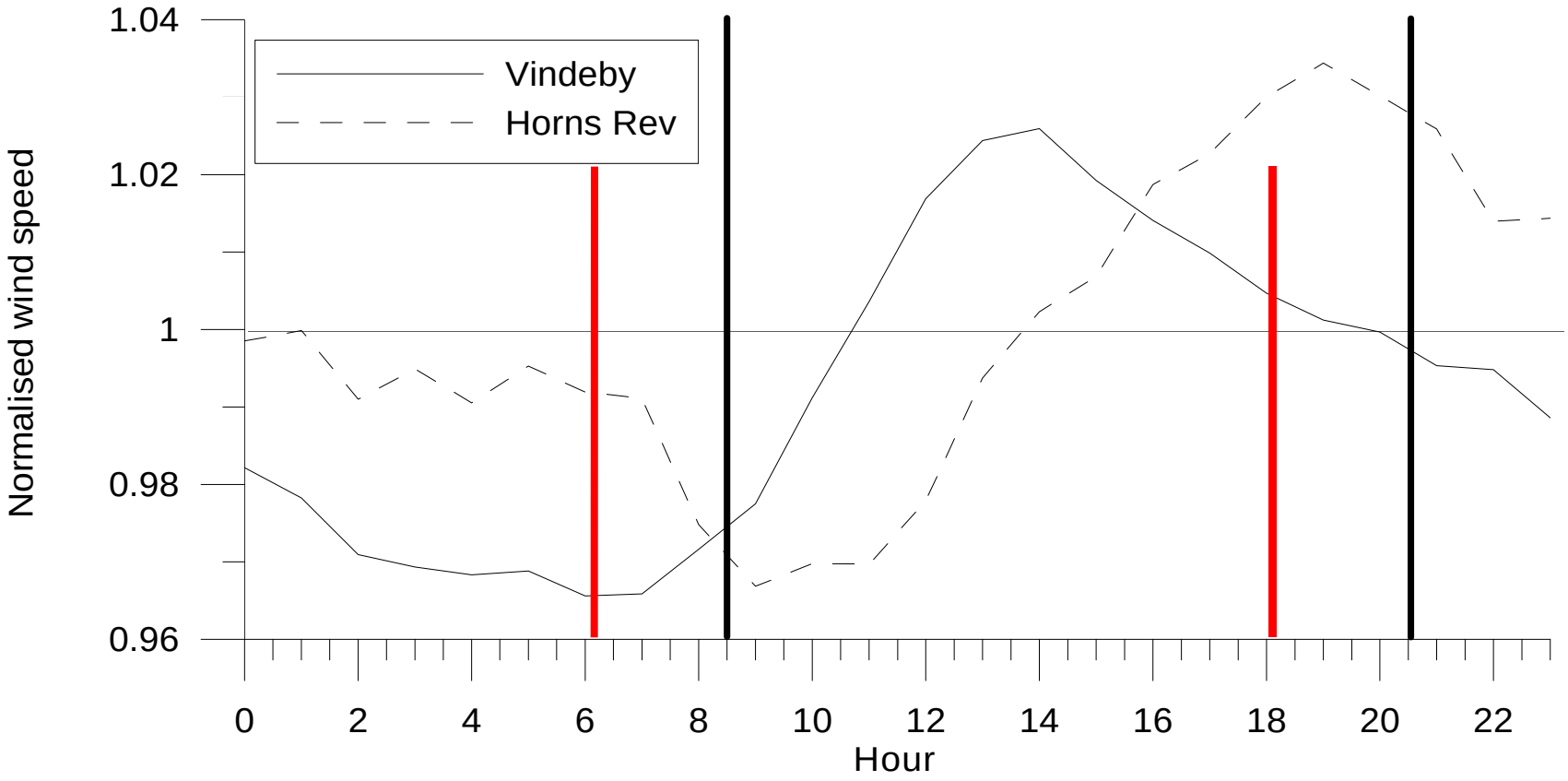


## Diurnal wind speed variation

Vindeby in Baltic Sea

Horns Rev in the North Sea

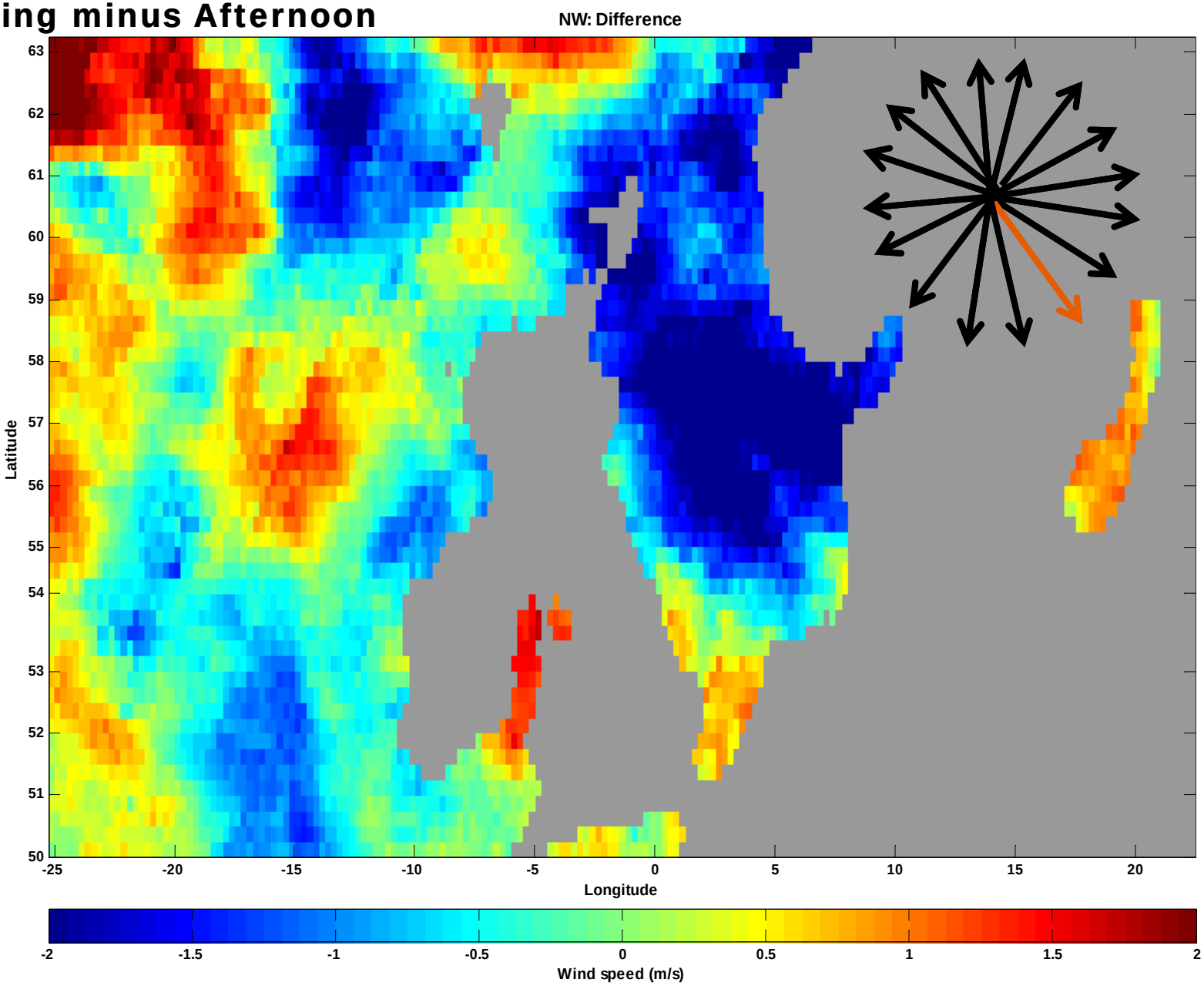
Sampling times: red vertical QuikSCAT and black Envisat ASAR



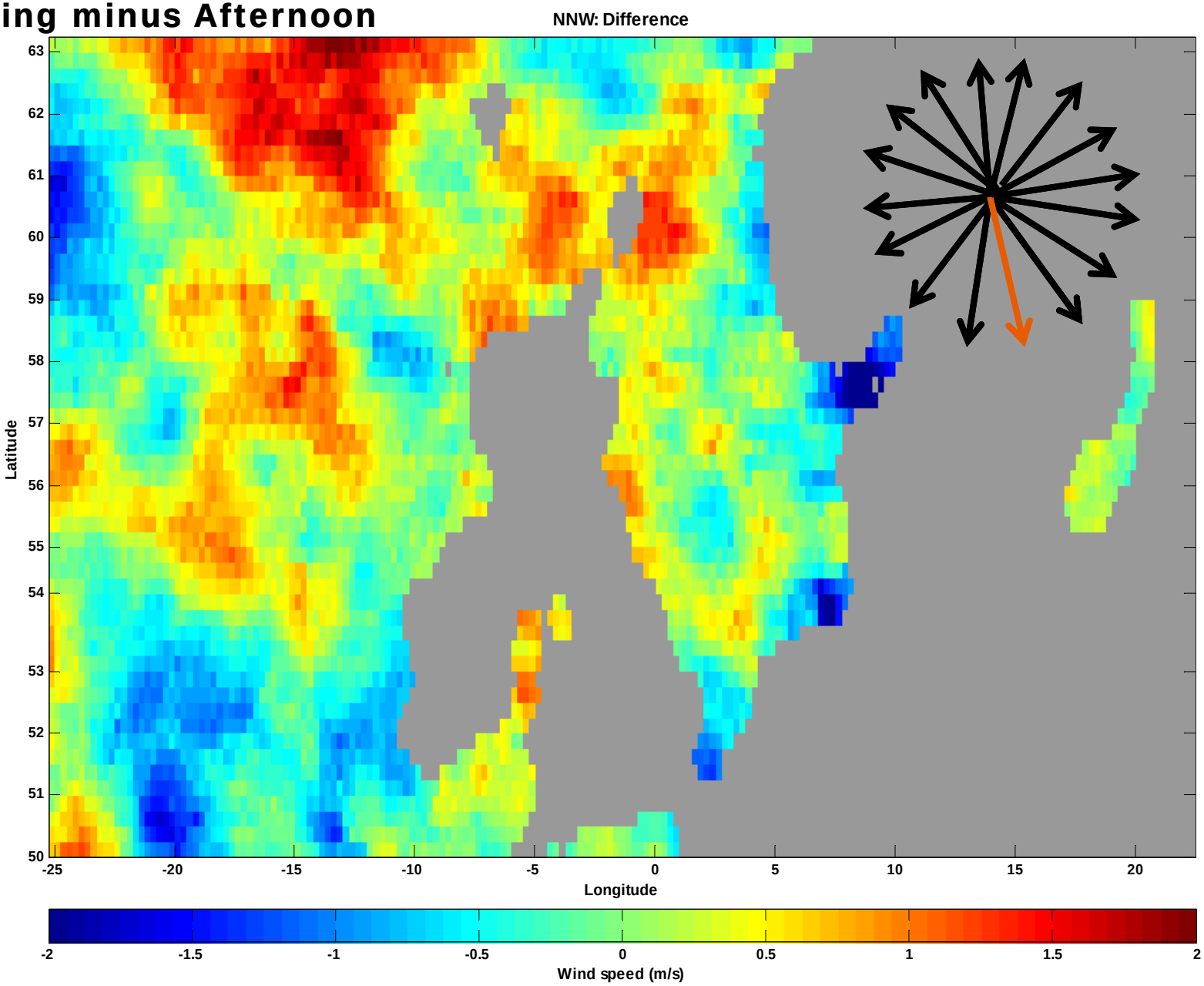

(Barthelmie & Pryor 2003: J. Applied Meteorology 42, 83-94)

Average Wind Speed: Difference (based on wind direction at Horns Rev) - 16 Directions

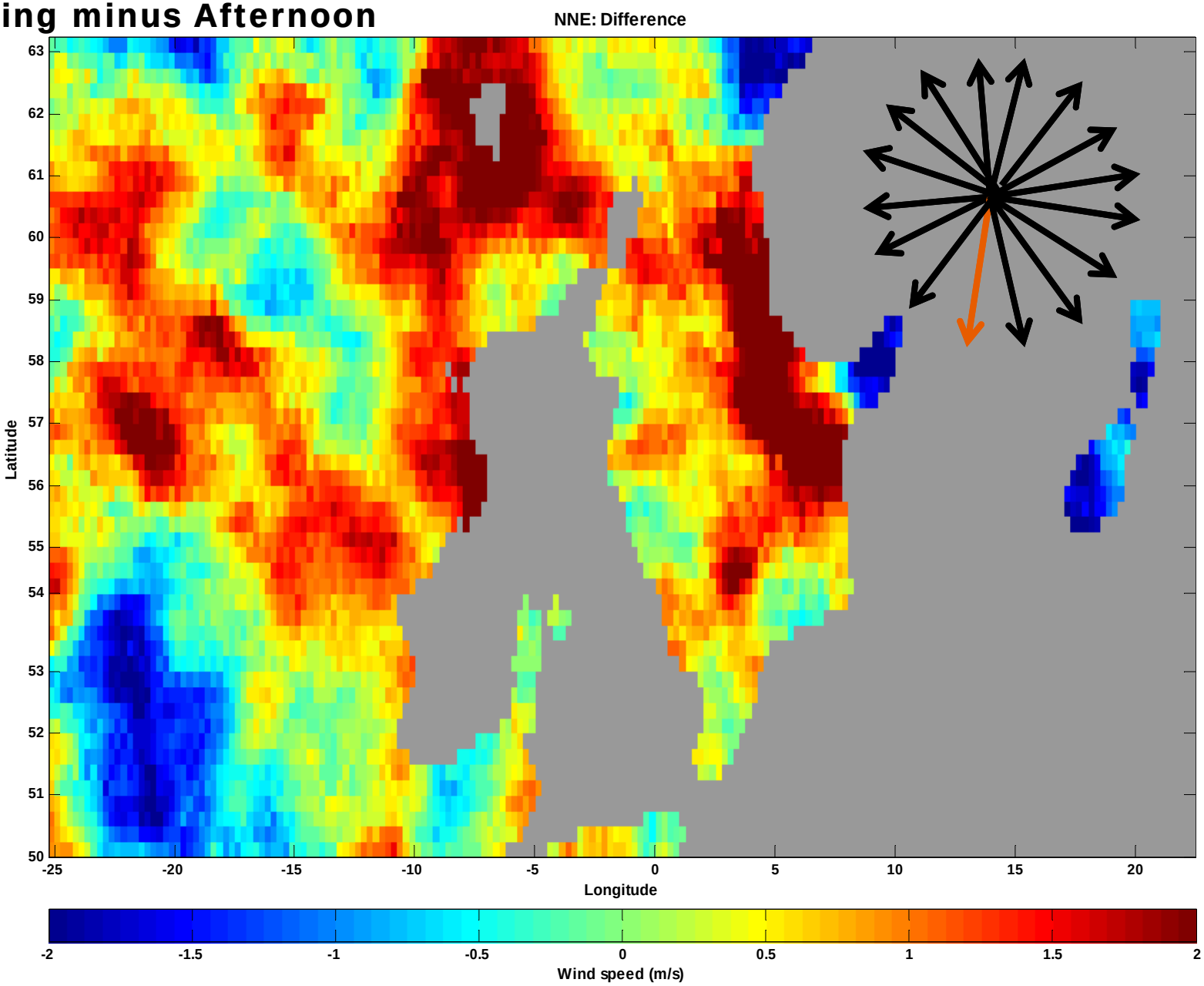
**Morning minus Afternoon**



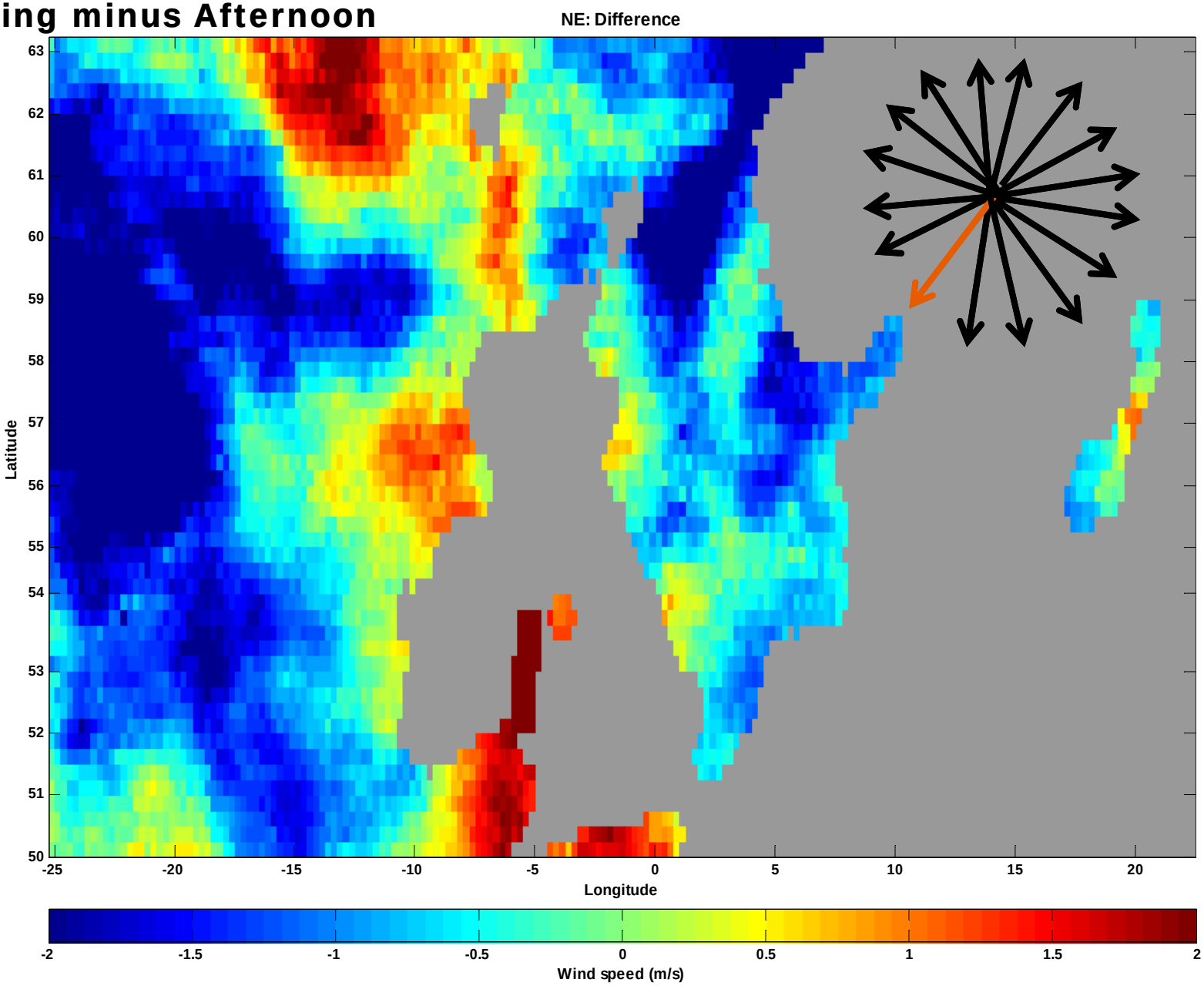
# Morning minus Afternoon



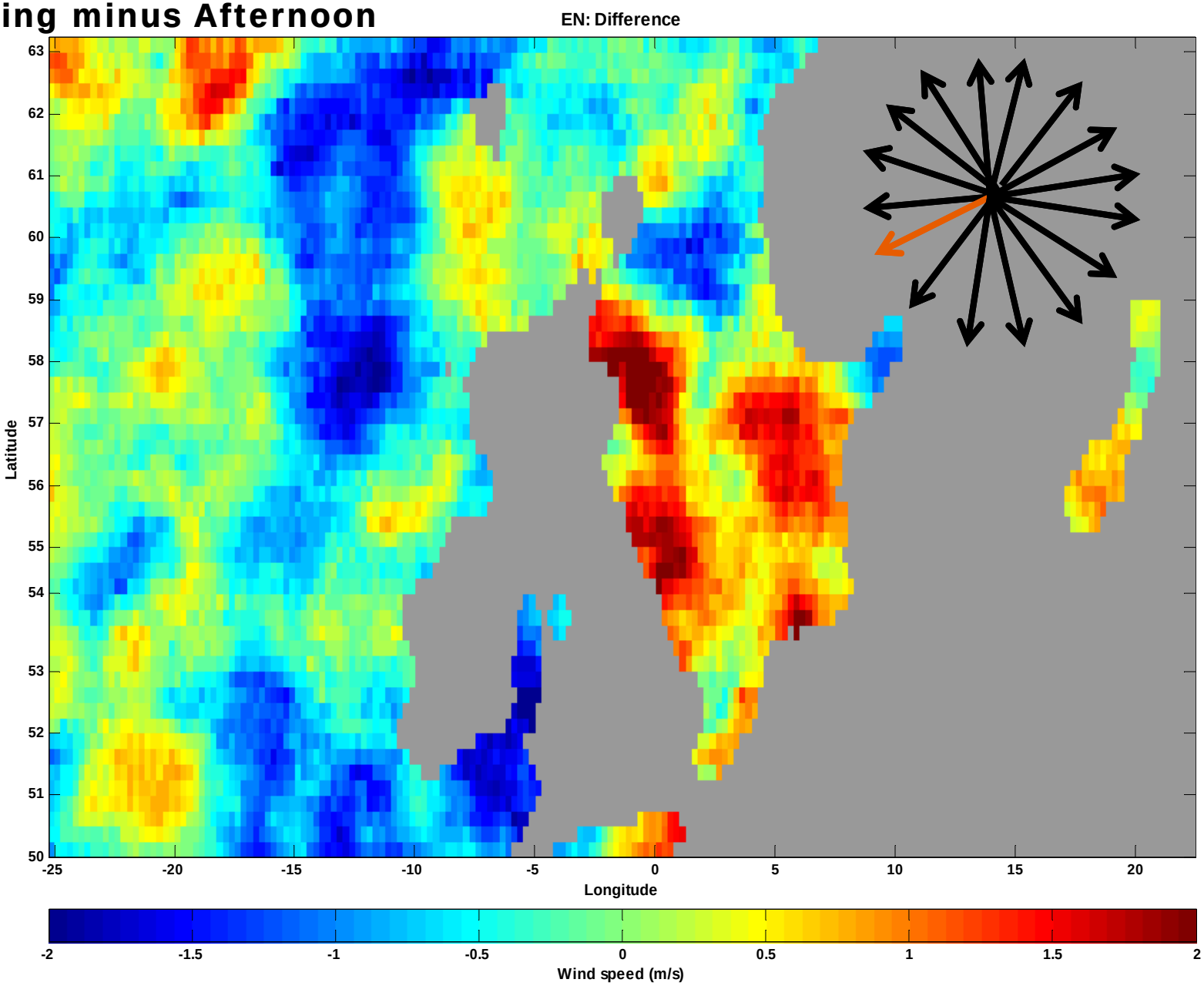
# Morning minus Afternoon



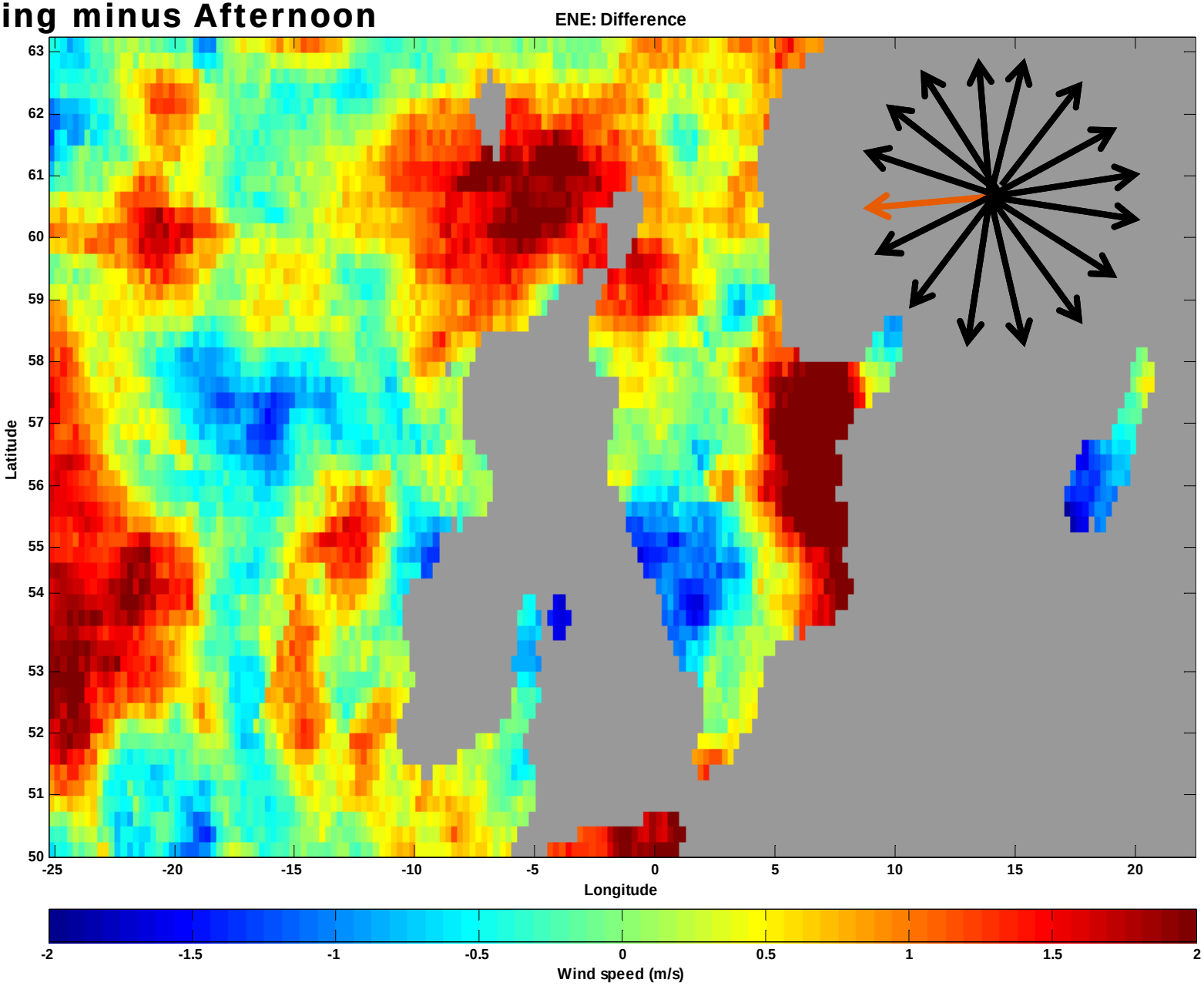
# Morning minus Afternoon



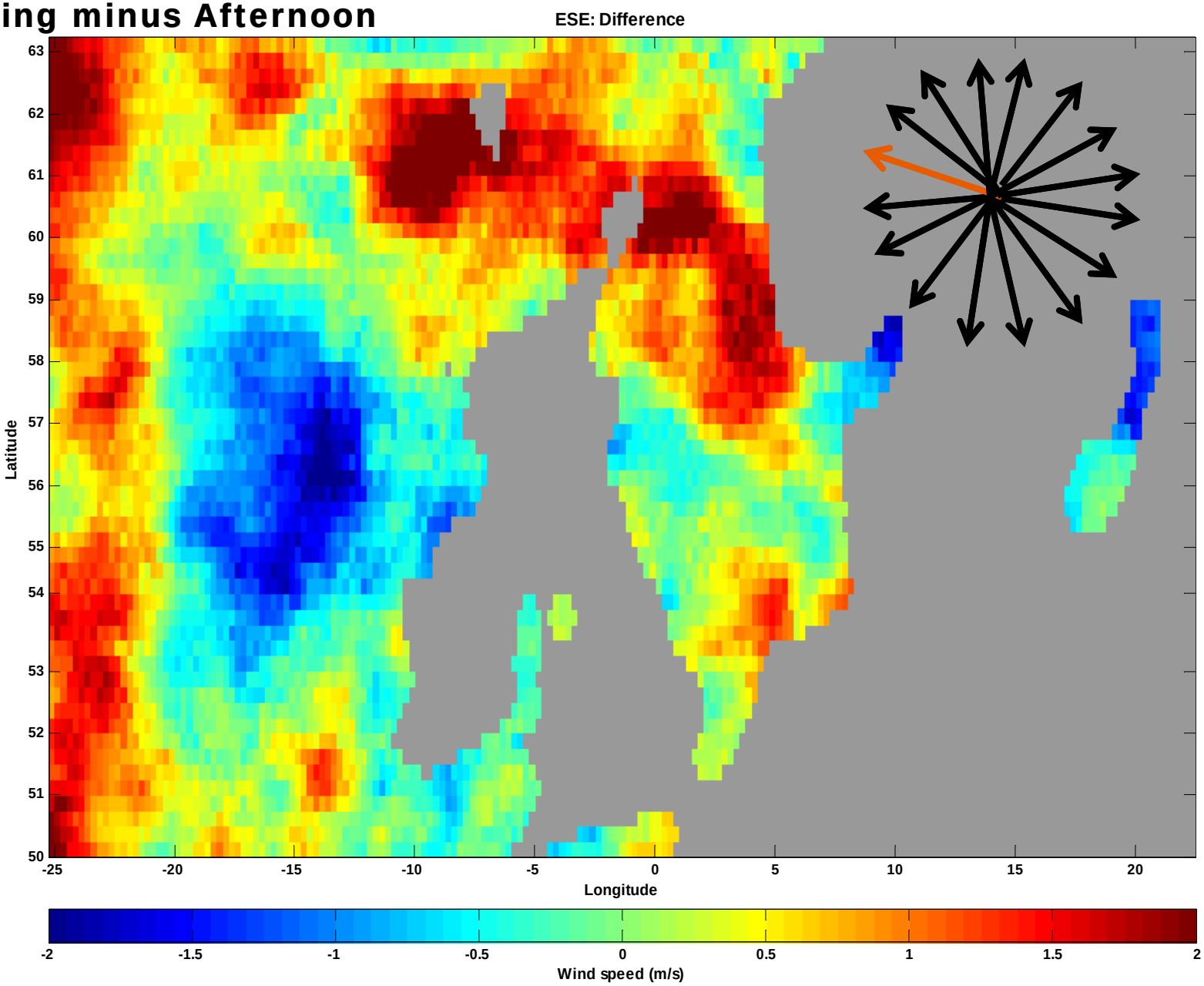
# Morning minus Afternoon



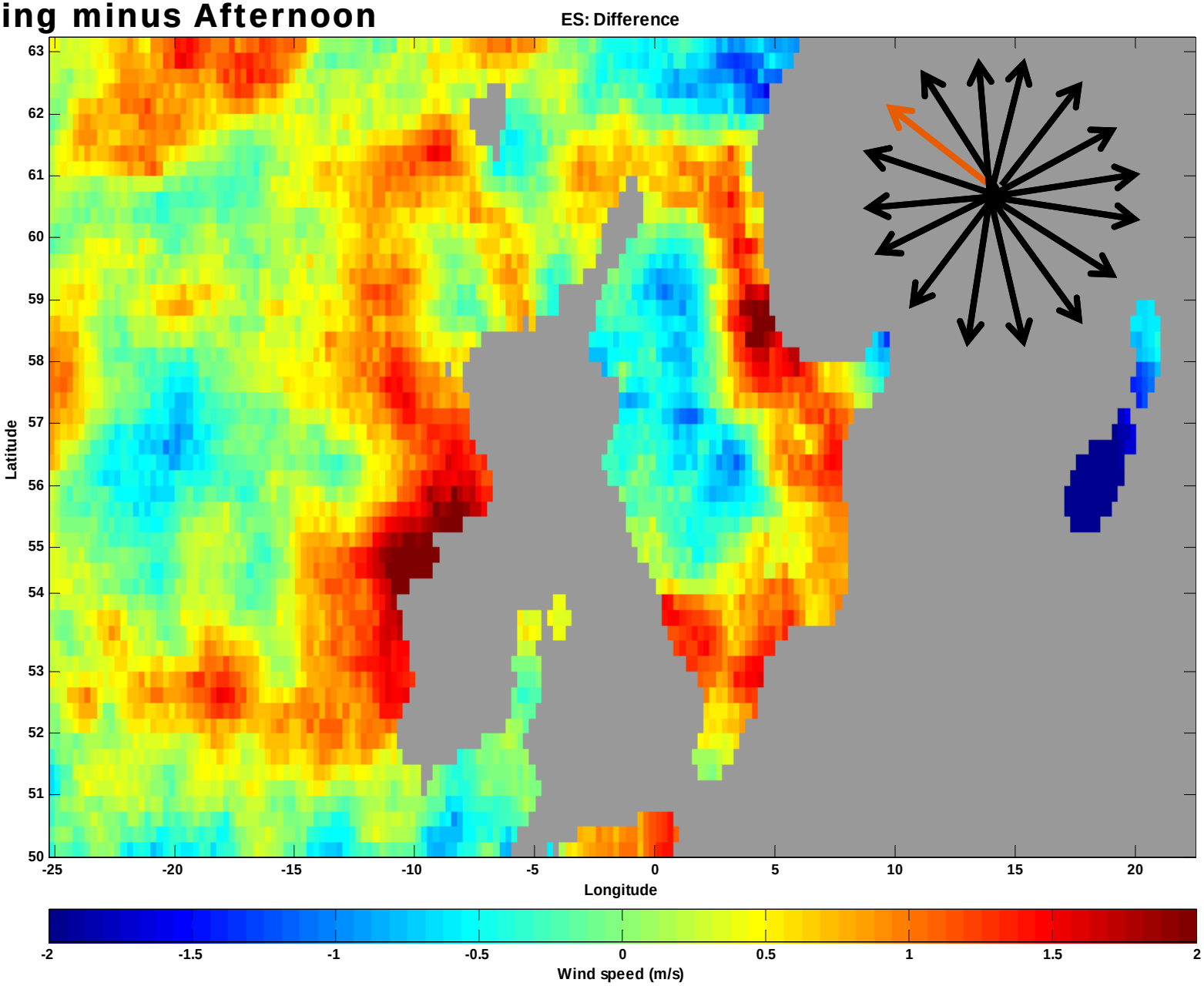
# Morning minus Afternoon



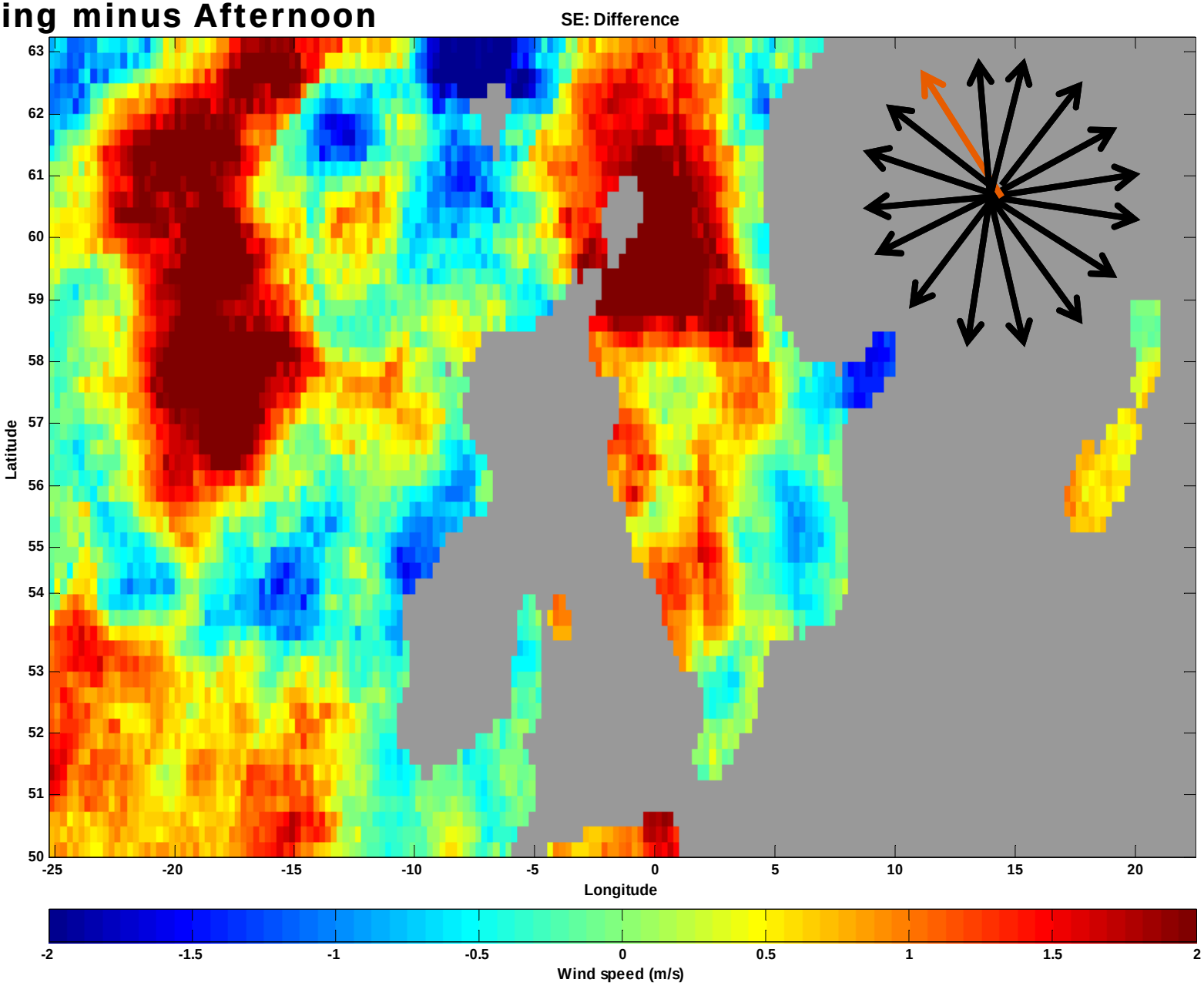
# Morning minus Afternoon



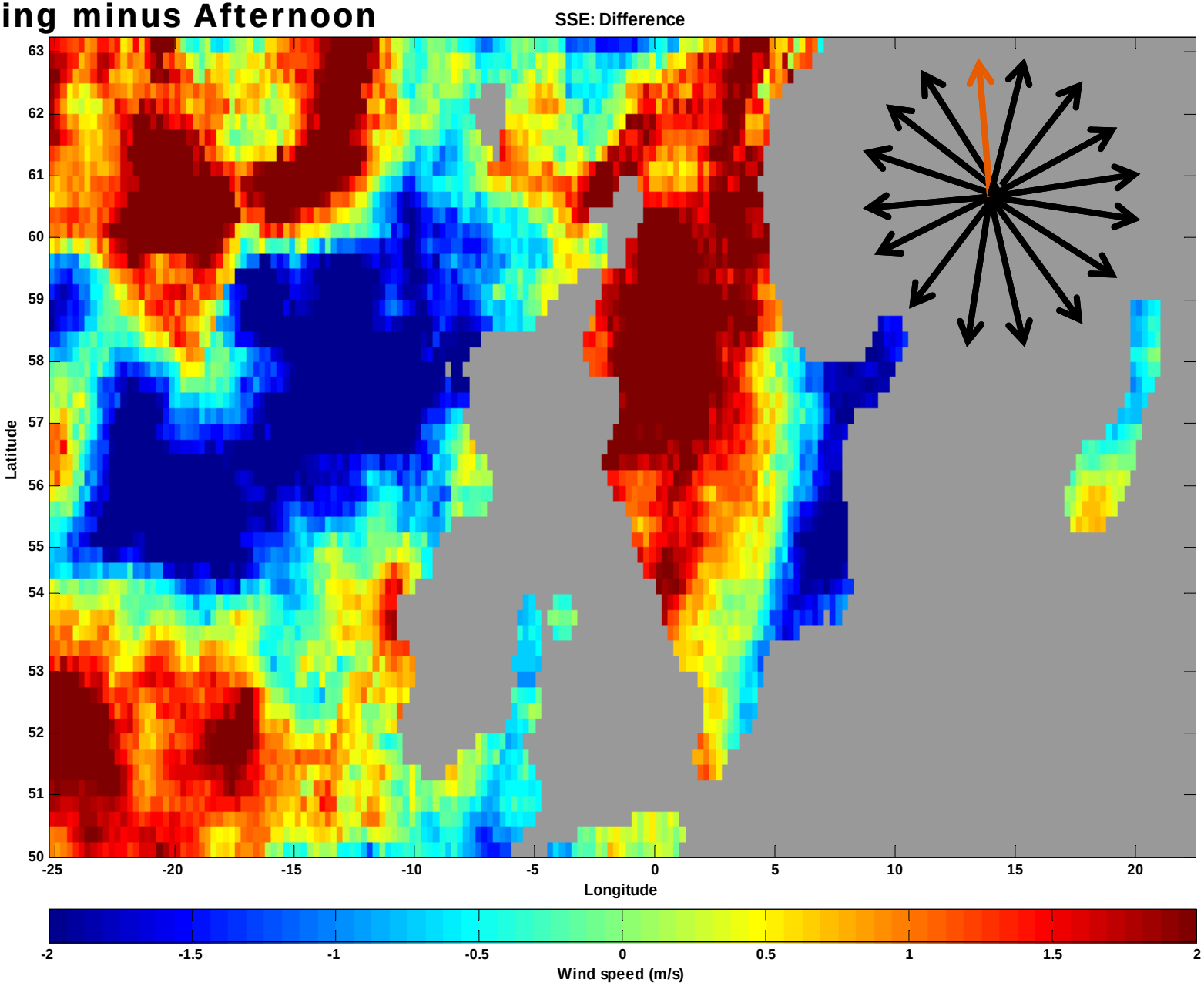
# Morning minus Afternoon



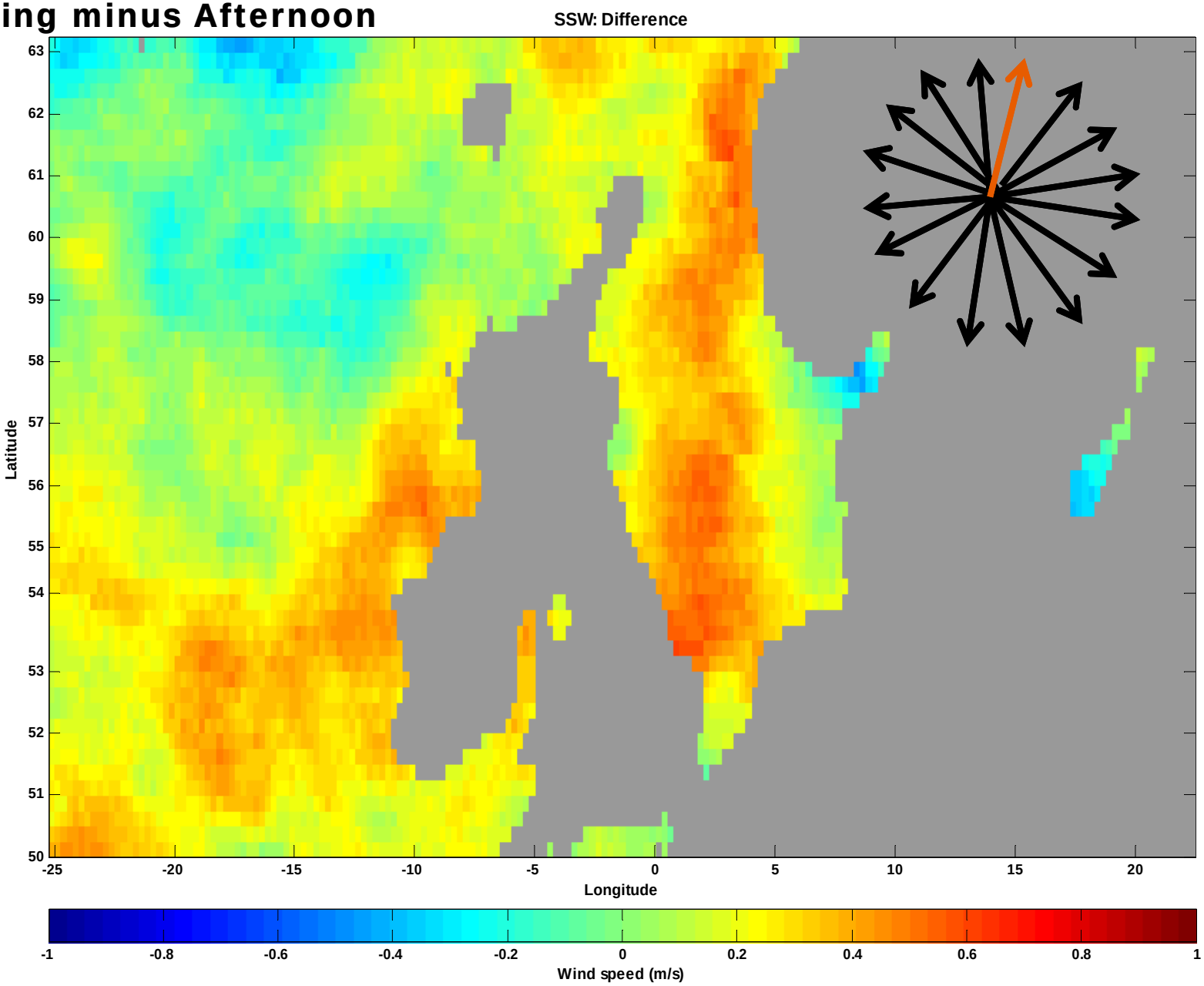
# Morning minus Afternoon



# Morning minus Afternoon



# Morning minus Afternoon



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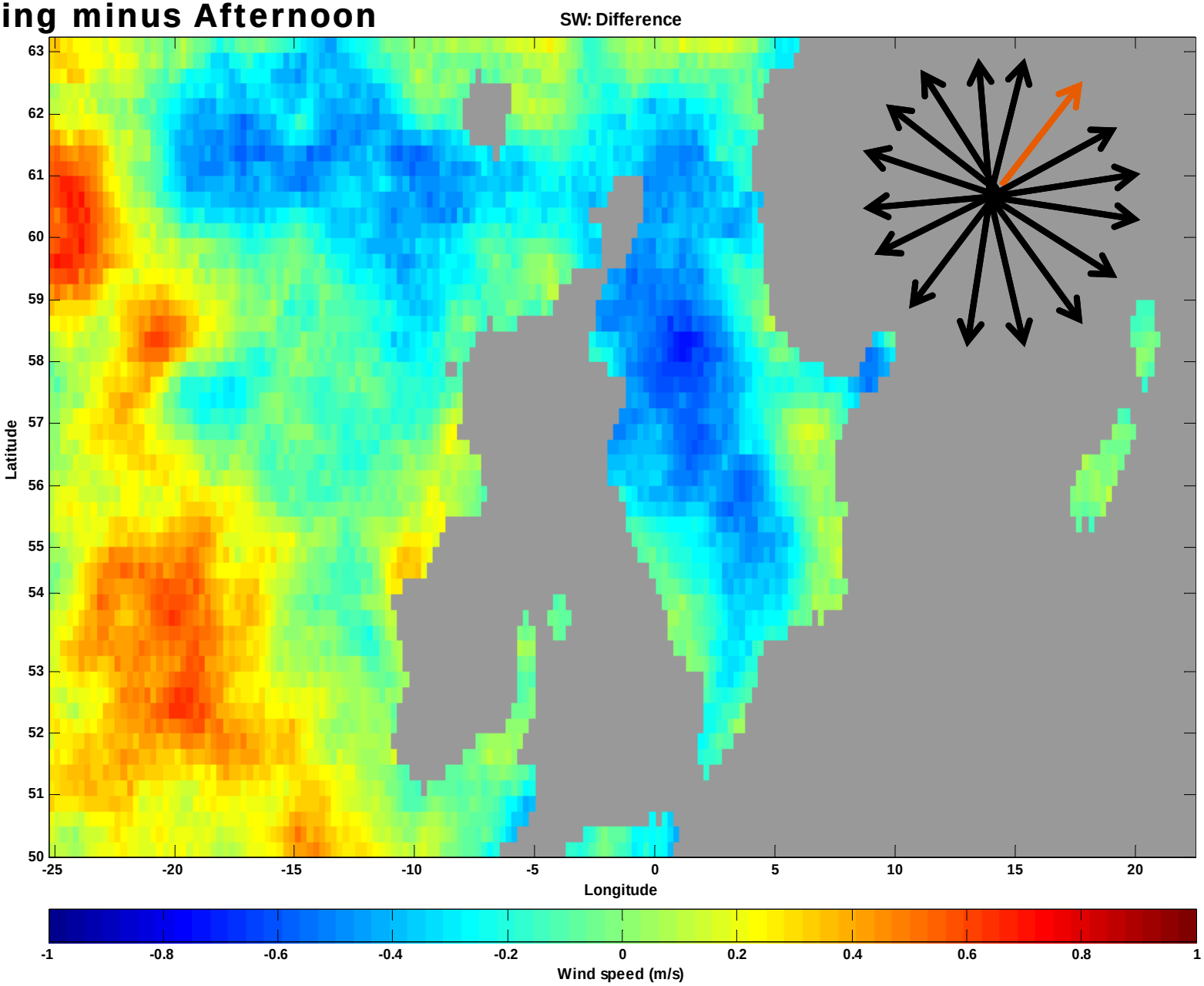

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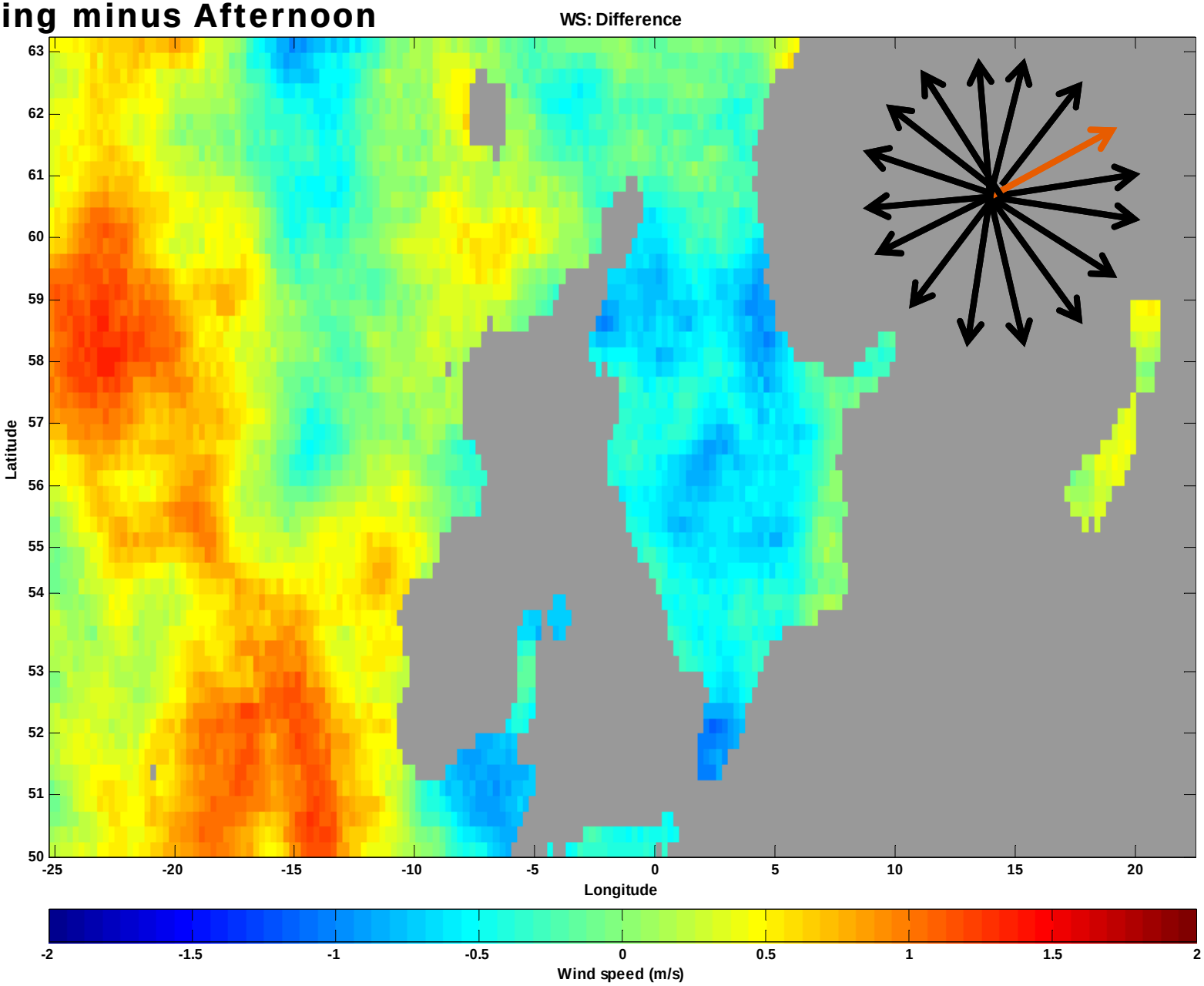

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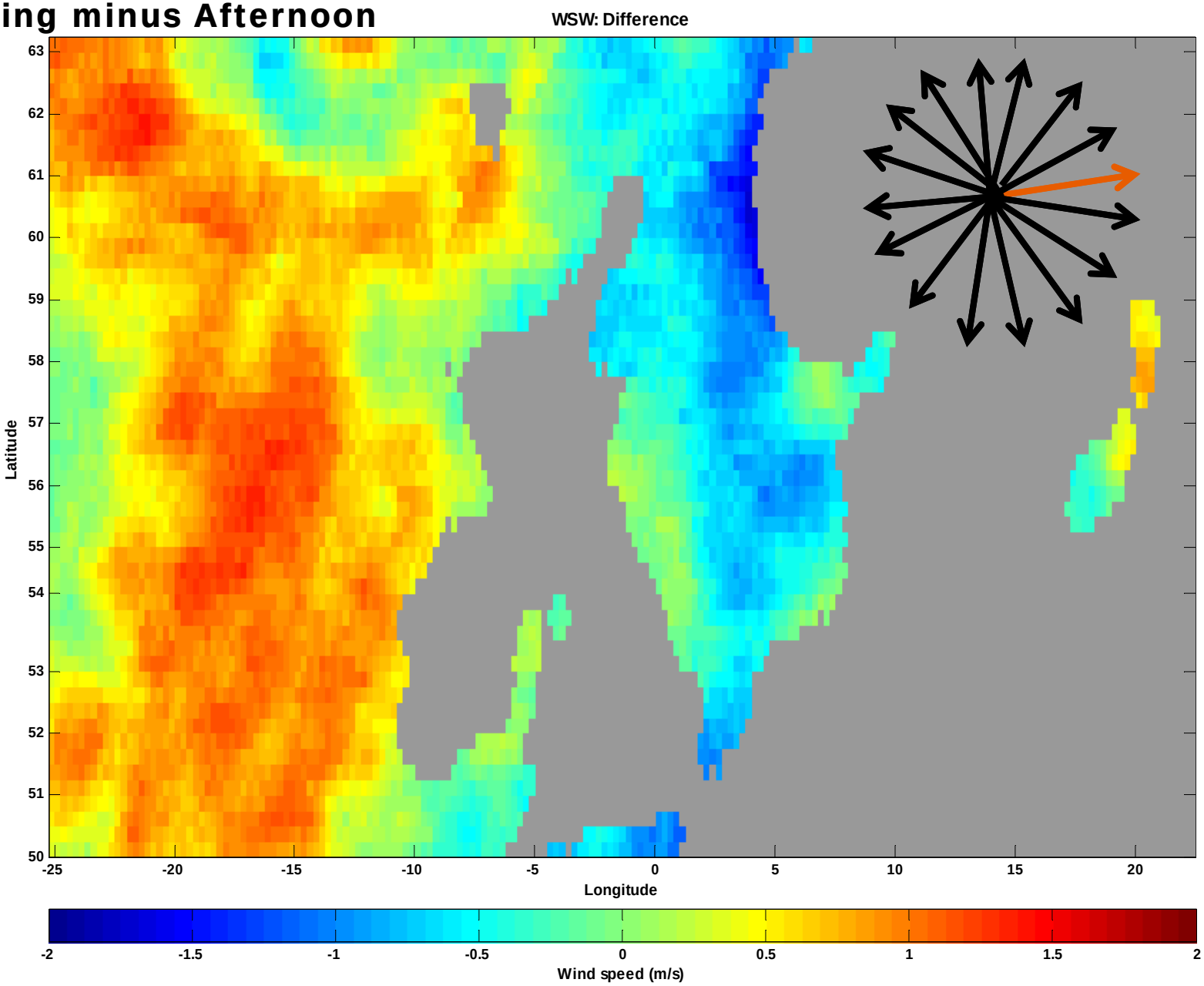

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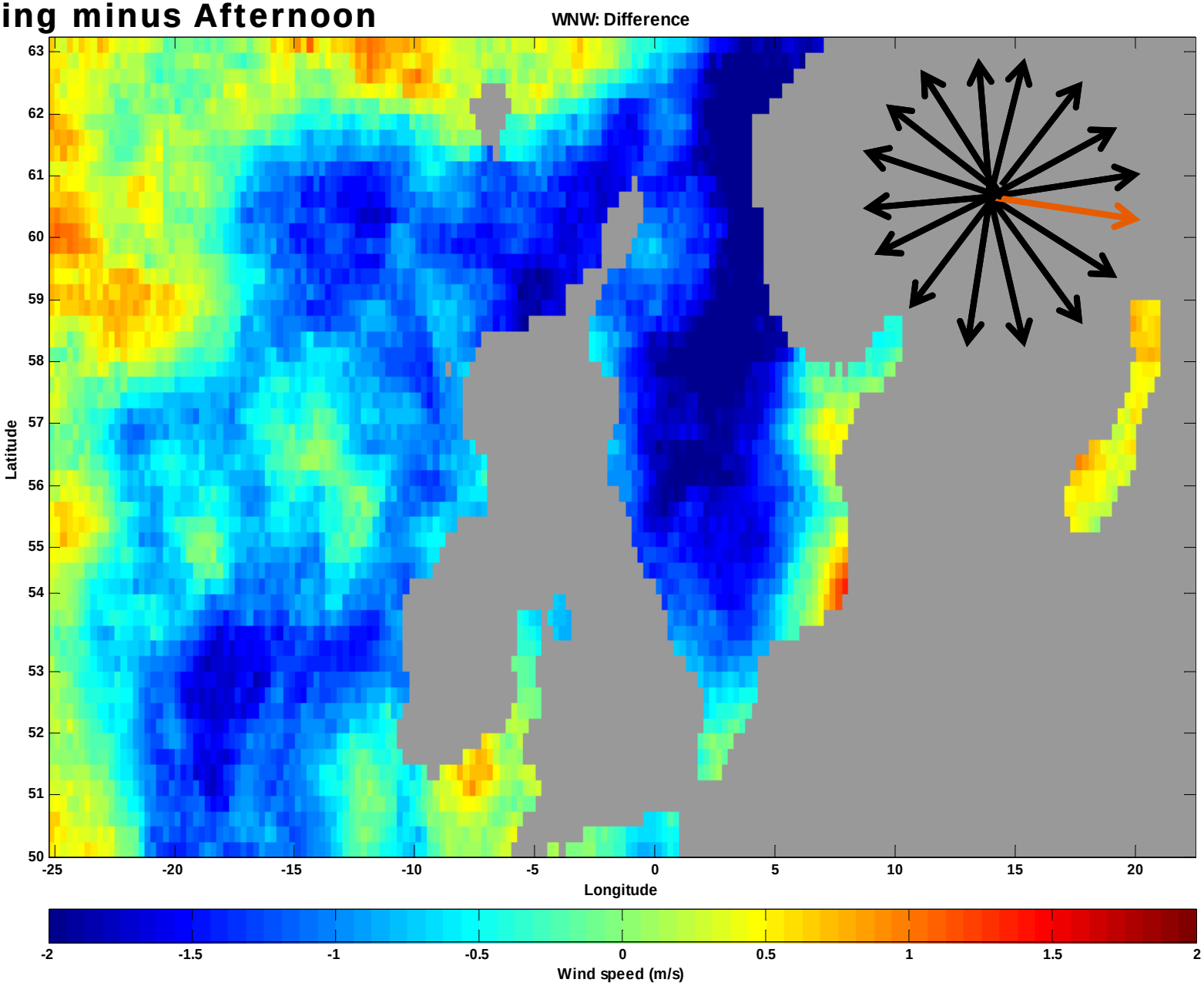
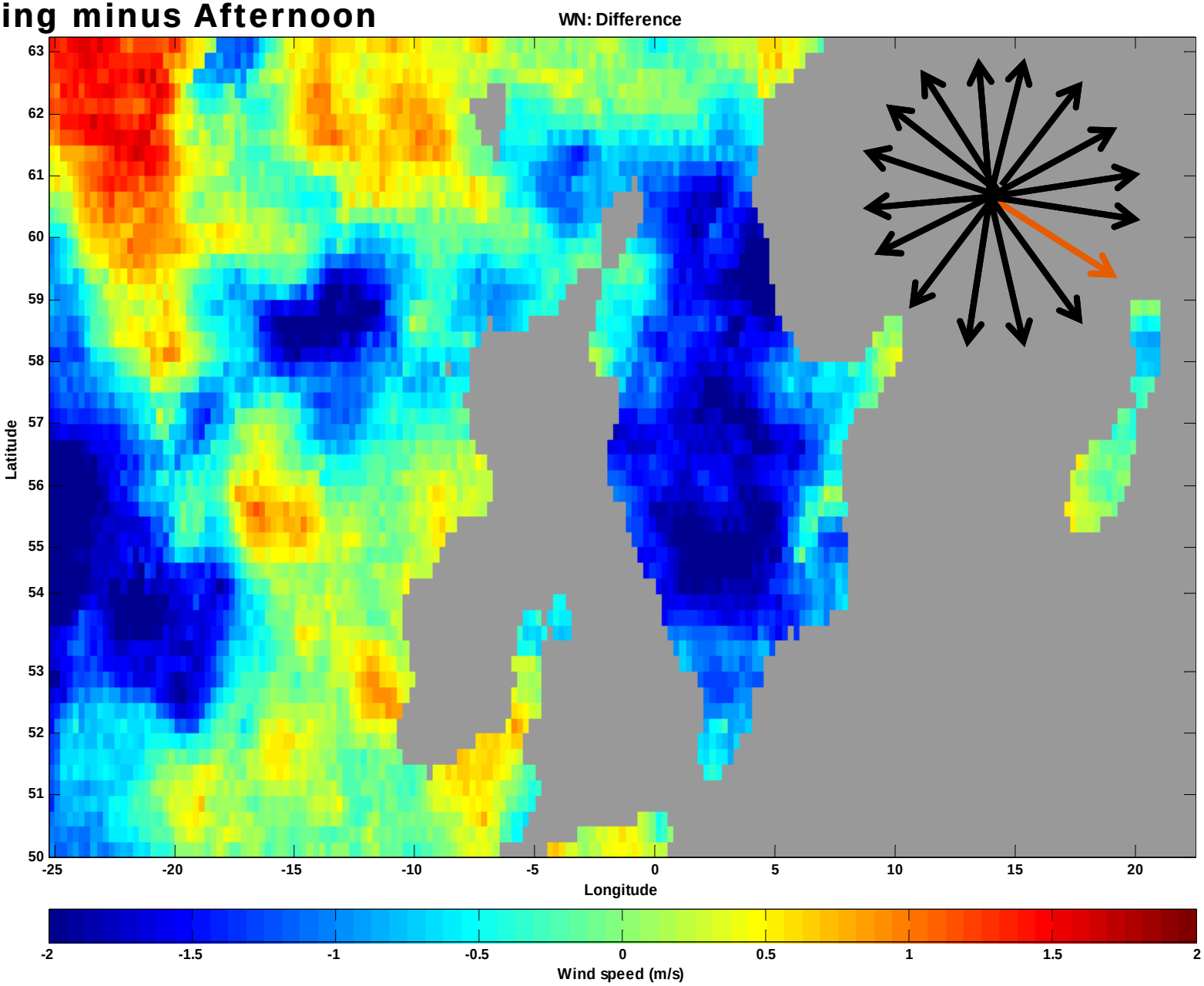
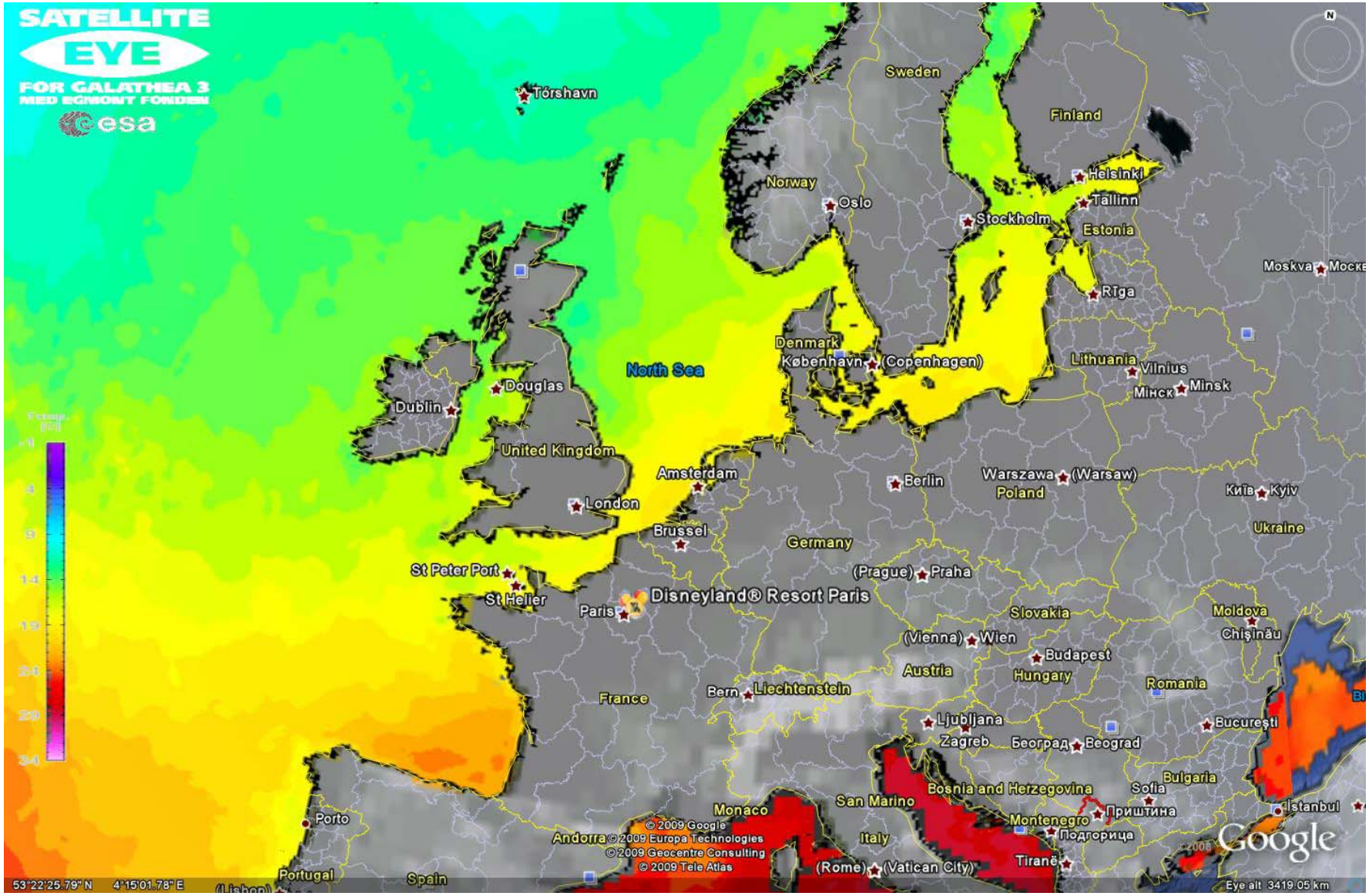


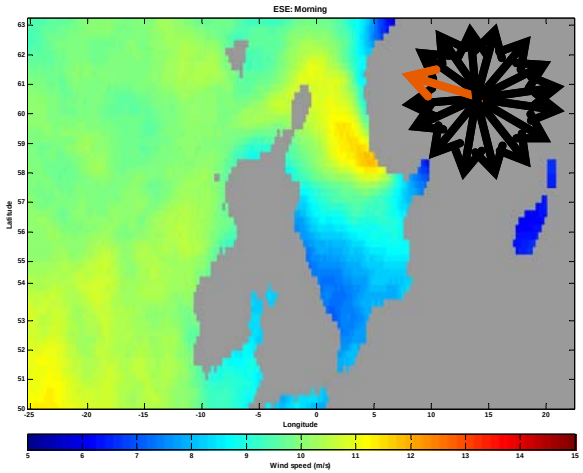
# Morning minus Afternoon

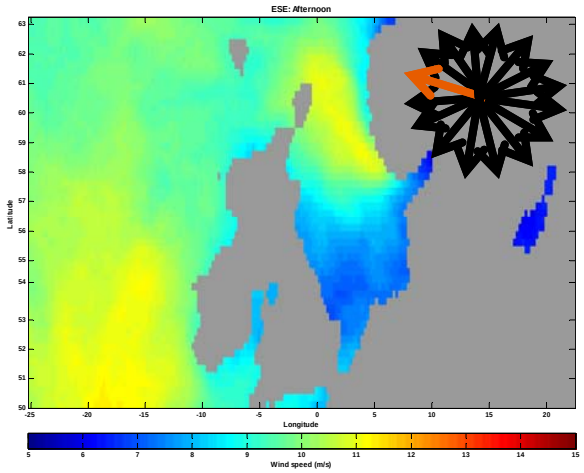


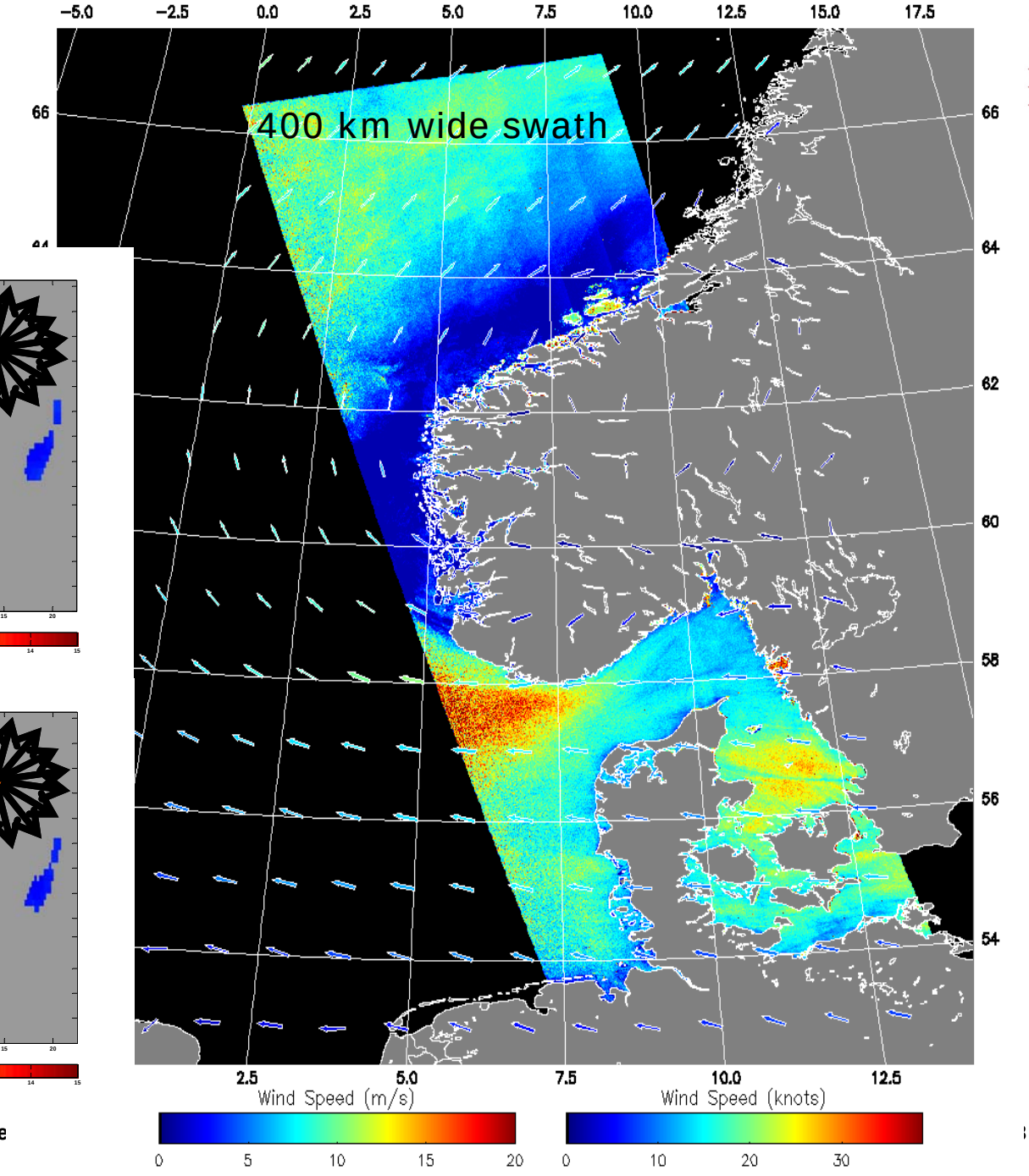
# Sea surface temperature: 30 August 2009



# Wind map from Envisat

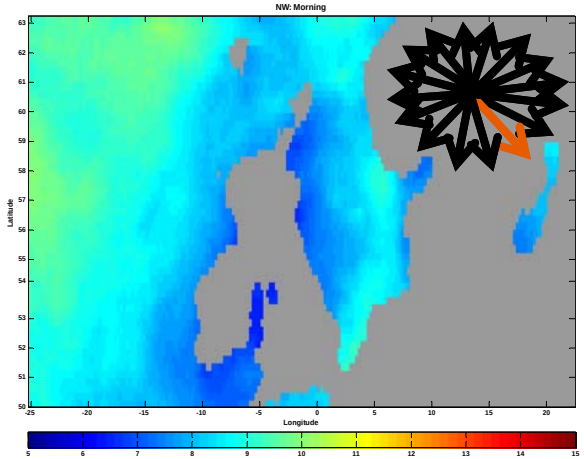


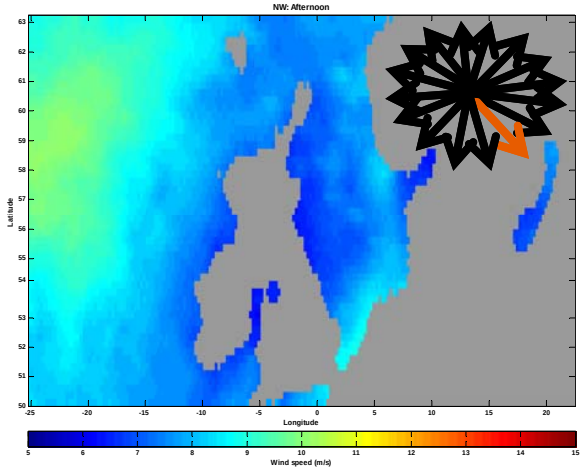



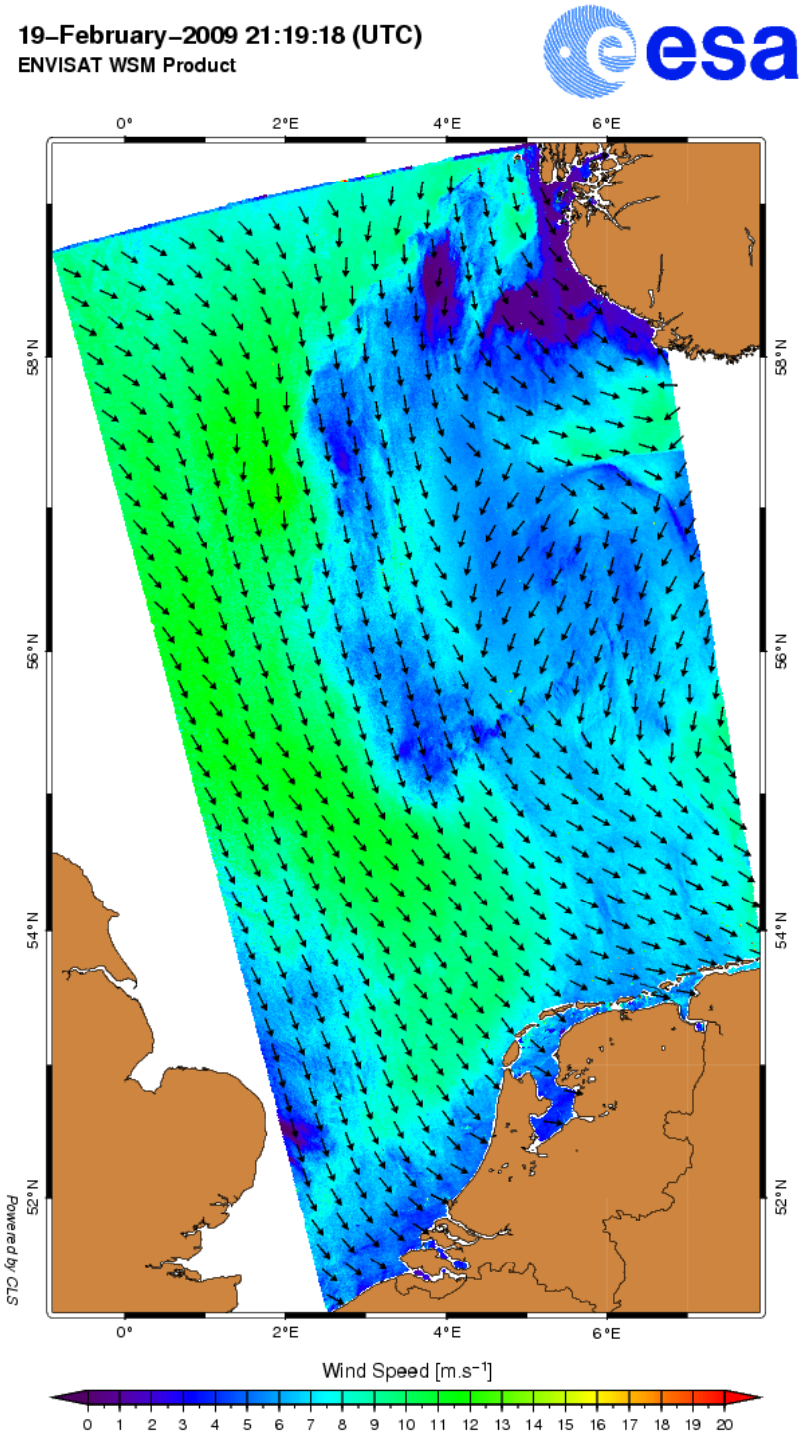



# Wind map from Envisat

Processed at



# Future

1. Detailed analysis of coastal, diurnal wind variations (QuikSCAT and Envisat)

2. Detailed analyis of offshore wind and sea surface temperature

3. Comparison to observations (EU-Norsewind)

4. Comparison to mesoscale model results (EU-Norsewind)

Further references:

Hasager et al. 2009 **Satellite winds in EU-Norsewind,** EWEC 2009 Scientific proceedings (ISBN: ) , pages: 144-147.

www.Norsewind.eu